**THE INSTITUTE OF MATHEMATICAL SCIENCES**

**C. I. T. Campus, Taramani,**

**Chennai - 600 113.**

# ANNUAL REPORT

**Apr 2012 - Mar 2013**

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**Foreword**

The Institute has completed 50 years last year and I am pleased to present this year's annual report and note the strength of the Institute and the distinctive achievements of its members.

Our student strength has increased to 121. We are proud to say that more and more students are getting benefitted from the thriving outreach programmes that we have and the efforts of our faculty, both at an individual and institutional level. Our post-doctoral student strength has gone up to 50.

Academic productivity of the members of Institute has remained high. There were several significant publications reported in national and international journals and our faculty have authored a few books as well. Two students were awarded Ph.D., seven submitted their Ph.D. theses and eight students submitted master's theses under the supervision of our faculty.

Sixteen conferences and workshops were organized at IMSc this year. These include IMSC golden Jubilee celebrations, 5th Indian conference in logic and applications, 14th conference on theoretical aspects of rationality and knowledge, Sunder Fest, ATM workshop on topology, Panorama lectures by Joseph Osterle, Panorama lectures by Kumar Murthy, Workshop on subfactors and planar algebra, Defects and heterogeneities in fracture and flow, INCF workshop on neuroinformatics of sensory-motor integration: modeling and imaging from the worm to the human nervous system, Frontiers in HEP.

The list of off-site conferences organized by IMSc faculty also continues to be impressive. This academic year conferences organized outside were: Advanced school on graph algorithms, Annual conference of the association of computing machinery, IMSC outreach three day workshop on algebra and its application, IMSC three day outreach workshop: introduction to field theory via geometry and number theory, Diversity and complexity: realm of today's statistical physics, Pathways to Higgs boson, XX DAE-BRNS HEP symposium.

We are proud to note the awards and honors bestowed on our faculty at the individual level. Prof.R Balasubramanian was awarded the Life time achievement award by the Hon'ble Prime Minister of India. Prof.Partha Chakraborty was awarded fellow of the National Academy of Sciences, India. Prof. Jaya Iyer was elected Fellow of the Indian Academy of Sciences. Prof.Ronojoy Adhikari has been awarded the Google research award by Google Incorporation, USA. Prof.Saket Saurabh has received the European Research Council award.

This report was compiled through the efforts of an Annual Report Committee comprising of Drs. Purusattam Ray, R. Ramanujam, Anilesh Mohari, Paul Pandian and Usha Devi. I owe my gratitude to all of them.

August, 2013 **R. Balasubramanian**

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# The Institute

## 1.1 Board

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Prof. **Sudhanshu Jha,** 402, Vigyanshila, Juhu-Versova Link Road, Seven Bungalows, Andheri(W), Mumbai 400 061.
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# Chapter 2

# Research and Teaching

## 2.1 Mathematics

### 2.1.1 Research Summary

#### Algebra

The similarity problem for matrices over rings like $\mathbf{Z}/p^2\mathbf{Z}$ where $p$ is a prime (more generally, over principal ideal local rings of length two) falls into a class of problems which are called wild, and considered intractable in general. Using formal matrix reduction techniques it has recently become possible to compute the number of similarity classes of such matrices while treating the prime $p$ as a variable [**Pr3**] up to $4 \times 4$ matrices. A surprising finding of these investigations is that for matrices up to size $4 \times 4$, the number of similarity classes is a polynomial function of $p$, and that this polynomial has non-ngeative integer coefficients which are independent of the ring in question.

The lattice of subgroups of a finite abelian group has a rich and well-developed theory. However, the equally important problem of classifying such subgroups up to automorphisms is very poorly understood. The former theory relies heavily on modern combinatorial methods in the analysis of partially ordered sets (posets). The discovery of an interesting poset structure (using the concept of degeneration) on the set of automorphism orbits of subgroups [**D**] makes it now possible to study subgroups up to automorphism using poset-theoretic techniques.

#### Algebraic Geometry

Study of morphisms to Grassmannians continued. A new construction of Null correlation bundle on projective three space was obtained [**Kr**]. Study of deformations of moduli space of Hitchin pairs on curves is taken up.

Moduli of equivariant sheaves has been constructed using moduli of Kronecker-McKay modules. As an application of this approach, we obtained explicit description of homogeneous coordinates on these moduli spaces in terms of determinantal semi-invariants [**A**].

### Analytic Number Theory

The problem of showing infinitely many zeros on the critical line for any $L$-function of degree $d > 2$ is an extremely challenging one. Work has been done to show that under a certain necessary condition the analogue of Hardy's theorem is true for any $L$-function of degree $d > 2$ in the Selberg class.

In [**S**], existence of infinitely many zeros of generalized Hurwitz zeta functions in their domain of absolute convergence is shown. This is a generalization of a classical problem of Davenport, Heilbronn and Cassels about infinitude of zeros of Hurwitz zeta function in the same half plane. Also zero-free regions for such functions is studied and consequently a variant of an old conjecture of Erdös is established.

### Ergodic Theory

A combinatorial approach to the calculation of volumes of balls in Bruhat-Tits buildings reduces these calculations to computations of truncated Poincaré series of affine Weyl groups. This in turn can be formulated as a calculation of the number of lattice points in a convex polytope. This approach was used to compare the growth of volumes of balls in the bulding over a field with the sub-building corresponding to a subfield [**Pr2**].

### Lie groups

By interpreting the centre of the Schur algebra as the centre of the group algebra of the symmetric group via Schur-Weyl duality, a combinatorial description of the expansion of the primitive central idempotents of the Schur algebra in terms of a the standard basis of this algebra was given [**?**].

### Mathematical Physics

Spectral statistics for decaying randomness was studied and results obtained for energies in the absolutely continuous spectrum.

Lower bounds on the N dimensional Gaussian measure of the positive quadrant obtained for a class of spectral distributions of the covariance matrix.

### Modular forms

In [**Gu2**], the growth of the Petersson norms of Fourier-Jacobi coefficients $f_m$, for $m$'s in arithmetic progressions, of Siegel cusp forms $F$ of weight $k$ and genus $n > 1$ is estimated. As a consequence, a result of Böcherer, Bruinier and Kohnen is strengthened. Further, another result of Kohnen is sharpened.

### Non Commutative Geometry

There are two notions of Yang-Mills action functional in noncommutative geometry. We show that for noncommutative n-torus and for the quantum Heisenberg manifolds both these notions agree. We also prove a structure theorem on the Hermitian structure of a finitely generated projective modules over spectrally invariant subalgebras of $C^*$-algebras.

### Operator Algebras

We investigated a construction which associates a finite von Neumann algebra $M(\Gamma, \mu)$ to a finite weighted graph $(\Gamma, \mu)$. Pleasantly, but not surprisingly, the von Neumann algebra associated to to a flower with n petals is the group von Neumann algebra of the free group on n generators. In general, the algebra $M(\Gamma, \mu)$ is a free product, with amalgamation over a finite-dimensional abelian subalgebra corresponding to the vertex set, of algebras associated to subgraphs with one edge (or actually a pair of dual edges). This also yields natural examples of (i) a Fock-type model of an operator with a free Poisson distribution; and (ii) a C 8853; C-valued semi-circular element. ([**Ba1**])

We embarked on a study of $E_0$ semigroups on factors of all types (not necessarily of type I, which is the case to have received most attention to date). We identified a notion, which we call extendability, for endomorhisms of a fairly general class, and of $E_0$ semigroups of factors. We obtained a nice chracterisation of extendability, in [**Bi**]. And proceeded to show examples of extendable and non-extendable $E_0$-semigroups,

Motivated by a lemma due to Bercovici and Voiculescu, we obtained an analogue in finite factors of the classical minimax theorem due to Ky Fan regarding sums of eigenvalues of a self-adjoint matrix, and used this to obtain continuous generalisations of the classical (Courant-Fischer-Weyl) minimax theorem on eigenvalues of self-adjoint matrix, as well as the observation that the association of 'quantile function' to a self-adjoint element of a $II_1$ factor with continuous sistribution, is 'order-preserving'. ([**Ba2**])

### Representation Theory

Relationships between various bases for representation spaces for current algebras and affine algebras associated to a given finite root system are being investigated.

Polynomial analogues of string functions for the rank 2 affine algebra $\widehat{\mathfrak{sl}_2}$ were studied. They were shown to be related to radial averages of certain Hecke modular forms associated to indefinite lattices [**Sh2**], thereby generalizing work of Kac and Peterson.

A new interpretation of chromatic polynomials of graphs was obtained from the point of view of Lie algebras. In particular it was shown that the chromatic polynomial of a graph is essentially the $q$-Kostant partition function of the sum of the simple roots of the associated Kac-Moody algebra [**Ve1**].

### Transcendental number theory

[**Gu1**] traces the imprints of Ramanujan's work on the development of the modern theory of quasi-modular forms. Furthermore, the influence of Ramanujan's work on classical Eisenstein series in relation to modular transcendence theory is chalked out.

### 2.1.2 List of Publications

The list of publications follows the following conventions: firstly, names of (co)authors who are not IMSc members are marked with a superscript *; secondly, the citation labels used for cross-referencing with the research summary are constructed from the last name of the first IMSc author and finally the list is ordered alphabetically according to the labels.

[**A**]
**Sanjay Amrutiya and Umesh Dubey***.
Moduli of equivariant sheaves and Kronecker-McKay modules.
2013.
(Preprint: Presented in Conference at KSOM, Kozhikode).

[**B1**]
**R. Balasubramanian, Cecile Dartyge*, and Elie Mosaki***.
Sur la complexite de familles d'ensmebles pseudo-aleatoires.
*les Annales de l'institue Fourier*, 63, 2013.
( To be published).

[**B2**]
**R. Balasubramanian and S. Gun**.
On zeros of quasi modular forms.
*Journal of Number Theory*, **132(10)**, 2228, 2012.

[**B3**]
**R. Balasubramanian, Florian Luca*, and Dimbinaina Ralaivaosaona***.
On the sum of the first n values of the euler function.
2013.
(Preprint: -).

[**B4**]
**R. Balasubramanian and Prem Prakash Pandey***.
Density of primes in l-th power residues.
*Proceedings Mathematical Sciences*, **Vol. 123(1)**, 19–25, 2013.

[**B5**]
**R. Balasubramanian and Prem Prakash Pandey***.
Catalian equation over z[i] for even exponent.
2013.
(Preprint: -).

[**Ba1**]
**Madhushree Basu, Vijay Kodiyalam, and V. S. Sunder**.
From graphs to free products.
*Proc. (MathSci) of the Indian Acad. of Sciences*, **122(4)**, 547, 2012.

[**Ba2**]
**Madhushree Basu and V. S. Sunder**.
Continuous minimax theorems.
*Canadian Bulletin of Mathematics*, 2013.
e-print arXiv:1210.7581 [math. OA] (Submitted).

[**Bi**]
**Panchugopal Bikram, Masaki Izumi*, R. Srinivasan*, and V. S. Sunder**.
Extendable endomorphisms of factors.
*Kyushu Journal of Mathematics*, 2013.
e-print arXiv:1211.2576. [math. OA] (To be published).

[**C1**]
**Partha Sarathi Chakraborty and Satyajit Guin**.
Equivalence of two approaches to yang-mills on non-commutative torus.
2013.
arXiv:1304.7616 (Submitted).

[**C2**]
**Partha Sarathi Chakraborty and Satyajit Guin**.
Yang- mills on quantum heisenberg manifolds.
2013.
arXiv:1304.7617 (Submitted).

[**Ch**]
**Prateep Chakraborty and Parameswaran Sankaran**.
Formality of certain cw complexes and applications to formality of schubert varieties and torus manifolds.
*Journal of Ramanujan Mathematical Society*, 2012.
(Submitted).

[**Cha1**]
**Hassan Azad*, Indranil Biswas*, and Pralay Chatterjee**.
On the maximal solvable subgroups of semisimple algebraic groups.
*Journal of Lie Theory*, **22(4)**, 1169, 2012.

[**Cha2**]
**Indranil Biswas* and Pralay Chatterjee**.
On the exactness of kostant-kirillov form and the second cohomology of nilpotent orbits.
*International Journal of Mathematics*, **8(23)**, 25, 2012.

[**Cha3**]
**Pralay Chatterjee**.
On abstract homomorphisms of algebraic groups.
2013.
(Preprint: 2013).

[**Chat**]
**Tapas Chatterjee and Sanoli Gun**.
Generalization of a problem of Davenport, Heilbronn and Cassels.
2013.
(Submitted).

[**D**]
**Wesley Calvert*, Kunal Dutta, and Amritanshu Prasad**.
Degeneration and orbits of tuples and subgroups in an abelian group.
*Journal of Group Theory*, **16**, 221, 2013.

[**G1**]
**T. Geetha and Frederick M. Goodman***.
Cellularity of wreath product algebras and $a$–brauer algebras.
2012.
arXiv:1208.2983 [math.RT] (Submitted).

[**G2**]
**T. Geetha and Amritanshu Prasad**.
The center of the schur algebras.
2013.
arXiv:1303.2475 (Submitted).

[**Gu1**]
**S. Gun and B. Moriya**.
Ramanujan, quasi-modular forms and transcendence.
Jan 2013.
(Submitted).

[**Gu2**]
**S. Gun and N. Kumar***.
A note on Fourier-Jacobi coefficients of Siegel modular forms.
2013.
(Submitted).

[**Gu3**]
**S. Gun, R. Murty*, and P. Rath***.
A note on special values of L-functions.
*Proc. of Amer. Math. Soc.*, 2012.
(To be published).

[**Gu4**]
**S. Gun, R. Murty*, and P. Rath***.
Linear independence of Hurwitz zeta values and a theorem of Baker-Birch-Wirsing over number fields.
*Acta Arithmetica*, **155(3)**, 297, 2012.

[**K**]
**Vijay Kodiyalam**.
On the genesis of a determinantal identity.
*Journal of the Ramanujan Mathematical Society*, 2012.
(To be published).

[**Kr**]
**Dan . Krishanu and Nagaraj D. S**.
Null correlation bundle on projective three space.
2012.
(Submitted).

[**Kri1**]
**Debargha Banerjee* and Srilakshmi Krishnamoorthy**.
The eisenstein elements inside the space of modular symbols.
2013.
(Submitted).

[**Kri2**]
**Srilakshmi Krishnamoorthy**.
On subfields of the modular function fields.
*Bull. KMA*, 2013.
(To be published).

[**Kri3**]
**Srilakshmi Krishnamoorthy and Neil Dummigan***.
Powers of 2 in modular degrees of modular abelian varieties.
*Journal of Number Theory*, **133(2)**, 501–522, 2013.

[**M1**]
**Krishna M**.
Absolutely continuous spectrum and spectral transition for some continuum random operators.
*Proc. Ind. Acad. Sciences*, **122(2)**, 243, 2012.

[**M2**]
**Krishna M, Kaminaga Masahiro*, and Nakamura S***.
Analyticity of density of states.
*Journal of Statistical Physics*, **149(3)**, 496, 2012.

[**M3**]
**Peter Stollmann* and Krishna M**.
Direct integrals and spectral averaging.
*Journal of Operator Theory*, **69(1)**, 101, 2013.

[**Mu**]
**Jon Bannon*, Jan Cameron*, and Kunal Mukherjee**.

Completely positive joinings of $II_1$–factor dynamical systems.
2012.
(Preprint: ).

[**P1**]
**Pampa Paul, K. N. Raghavan, and P. Sankaran**.
$l_0$-types common to a borel-de siebenthal discrete series and its associated holomorphic discrete series.
*Comptes Rendus Acad. Science, Paris, Sr. I*, **350**, 1007, 2012.

[**P2**]
**Pampa Paul, K. N. Raghavan, and Parameswaran Sankaran**.
$l-0$-types common to a borel-de siebenthal discrete series and its associated holomorphic discrete series.
*C.R. Math. Acad. Sci. Paris.*, **350(23-24)**, 1007–1009, 2012.

[**P3**]
**Pampa Paul, K. N. Raghavan, and Parameswaran Sankaran**.
$l_0$-types common to a Borel-de Siebenthal discrete series and its associated holomorphic discrete series.
*Comptes Rendus Mathematique*, **350(23–24)**, 1007, 2012.

[**P4**]
**Pampa Paul, K. N. Raghavan, and Parameswaran Sankaran**.
$l_0$-types common to a Borel-de Siebenthal discrete series and its associated holomorphic discrete series.
2012.
(Preprint: arXiv:1210.0123).

[**Pr1**]
**Jayadev S. Athreya***, **Anish Ghosh***, **and Amritanshu Prasad**.
Ultrametric logarithm laws II.
*Monatshefte für Mathematik*, **167(3–4)**, 333, 2012.

[**Pr2**]
**Jayadev S. Athreya***, **Anish Ghosh***, **and Amritanshu Prasad**.
Buildings, extensions, and volume growth entropy.
*New York Journal of Mathematics*, **19**, 1, 2013.

[**Pr3**]
**Amritanshu Prasad, Pooja Singla***, **and Steven Spallone***.
Similarity of matrices over local rings of length two.
2012.
(Submitted).

[**S**]

[**Sh1**]
**Sachin S. Sharma and Sankaran Viswanath**.
The $t$-analog of the basic string function for twisted affine Kac-Moody algebras.
*Journal of Algebra*, **363**, 19, 2012.

[**Sh2**]
**Sachin S. Sharma and Sankaran Viswanath**.
The $t$-analogs of string functions for $a_1^{(1)}$ and hecke indefinite modular forms.
2013.
(Preprint: arXiv:1302.6200 [math.RT]).

[**Sn**]
**Indranil Biswas* and Nagaraj D. S.**
Reconstructing vector bundles on curves from their direct image on symmetric powers.
*Arch. Math. (Basel)*, **99(4)**, 327, 2012.

[**T**]
**Mubeena T and Sankaran Parameswaran**.
Twisted conjugacy classes in abelian extensions of certain linear groups.
*Canadian Mathematical Bulletin*, 2012.
(To be published).

[**V**]
**Arvind Nair* and Vaibhav Vaish**.
Weightless cohomology of algebraic varieties.
2012.
(Submitted).

[**Ve1**]
**R. Venkatesh**.
Chromatic polynomials of graphs from kac-moody algebras.
2013.
arXiv:1303.1148 [math.RT] (Submitted).

[**Ve2**]
**R. Venkatesh and Sankaran Viswanath**.
Unique factorization of tensor products for Kac-Moody algebras.
*Advances in Mathematics*, **231**, 3162, 2012.

## 2.2 Physics

### 2.2.1 Research Summary

#### Biological Physics

The uterus is normally an excitable medium which does not exhibit spontaneous activity. However, during pregnancy, the tissue changes its character and starts exhibiting transient episodes of self-excited oscillatory activity. Just before giving birth these oscillations become synchronized and the resulting organ-wide coherent activity allows the fetus to be ejected. Till date there has been no experimental evidence for a specialized pacemaker region in the uterus (unlike the heart) that can help coordinate this process. An alternative hypothesis has been put forward recently that proposes the oscillation to be arising from strong coupling between excitable cells and electrically passive cells which co-occur in the uterus. It is known that during pregnancy the gap junctions that couple these cells become numerous and also increase in conductance. By numerical simulations, it has been shown that this increase in coupling is sufficient to explain the emergence of spontaneous oscillations and their gradual synchronization resulting in system-wide coherent activity, explaining one of the long-lasting puzzles in uterine electrophysiology. A key role seems to be played by the highly variable distribution of passive cells which connect to an excitable cell. This can be seen as a form of quenched disorder, similar to that seen in glass systems studied in physics. A recent study has been undertaken to explore the role of this disorder in expediting the transition from queiscence to coherent oscillations in the pregnant uterus close to term [**Sin2**]. This reveals the importance of the spontaneously emerging "oscillation centers" in uterine tissue through local fluctuations in the passive cell density.

To validate whether the results of simplified models of excitable media are valid for the real, biological system, an investigation has been undertaken using a recently developed, highly detailed electrophysiological model of uterine myocyte cells. The study investigates how an increase in coupling between myocytes and neighbouring, electrically passive cells can give rise to spontaneous, contraction-inducing oscillatory electrical activity and finds results similar to those seen for the simpler model. In addition, the role of the strength of diffusive coupling between adjacent myocytes arranged on a two-dimensional lattice (with each myocyte coupled to a random number of passive cells that represents the structural disorder in biological tissue) on the collective dynamics has been investigated.

Intra-cellular signaling networks coordinate all the processes necessary for maintaining life by coordinating appropriate response to a wide variety of possible signals in the presence of a high degree of noise. It is important to idetify the strategies used by such networks that allow them to perform efficient and robust information processing. A very important structural motif in such networks is the three-component Mitogen-Activated Protein Kinase (MAPK) signalling module. This pathway is found in all eukaryotic cells and is involved in many critical cellular functions including cell cycle control, stress response, differentiation and growth. Its crucial importance is underscore by the fact that it is seen to be affected in many diseases including cancer, as well as, immunological and degenerative syndromes and is, therefore, an important drug target. The basic linear cascade structure involves regulation of the activity of a MAPK kinase kinase (MAP3K) enzyme by an upstream signal. MAP3K on being activated can act as the enzyme for activation of a MAPK kinase (MAP2K) enzyme which in turn controls the activity of a MAPK enzyme. MAPK, on activation, can be involved in many functions, such as initiation of transcription or stimulation of other kinases. However, such linear or chain-like reaction schemes imply a rigid relation between stimulus and response, precluding the possibility of the system switching to a different response for the same signal under altered circumstances. As many linear cascades are actually part of branched pathways [**Sinh3**] (e.g., the MAP3K enzyme MEKK-1 is known to activate multiple types of MAP2K enzymes in the T-cell and B-cell receptor signalling networks involved in immune response), it is important to investigate the dynamics of branched MAPK modules. In a recent study [**Sinh1**], it has been demonstrated that enzyme-substrate dynamics on such motifs allow surprisingly long-range communication  in the absence of direct long-range interaction between molecules  through retrograde propagation between the different (non-interacting) branches of MAPK pathways. Numerical simulations show that perturbing the activation of MAPK enzyme in one branch can result in a series of changes in the activity levels of molecules upstream to that enzyme, eventually reaching the branch-point and thence affecting the other branches. Our results have recently been verified by biological experiments (at NCCS, Pune). An important aspect of retrograde propagation in branched pathways that is distinct from previous work on retroactivity focusing exclusively on singlechains is that varying the type of perturbation, e.g., between pharmaceutical agent mediated inhibition of phosphorylation or suppression of protein expression, can result in opposing responses in the other branches. This can have potential significance in designing drugs targeting key molecules which regulate multiple pathways implicated in systems-level diseases such as cancer and diabetes.

The cell membrane is inherently asymmetric and heterogeneous in its composition, a feature that is crucial for its function. Using atomistic molecular dynamics simulations, the physical properties of a 3-component asymmetric mixed lipid bilayer system comprising an unsaturated POPC (palmitoyloleoylphosphatidylcholine), a saturated PSM (palmitoylsphingomyelin), and cholesterol are investigated. Our simulations explore both the dynamics of coarsening following a quench from the mixed phase and the final phase-segregated regime obtained by equilibrating a fully segregated configuration. Following a quench, the membrane quickly enters a coarsening regime, where the initial stages of liquid ordered, lo, domain formation are observed. These growing domains are found to be highly enriched in cholesterol and PSM. Consistent with this, the final phase-segregated regime contains large lo domains at equilibrium, enriched in cholesterol and PSM. Our simulations suggest that the cholesterol molecules may partition into these PSM-dominated regions in the ratio of 3:1 when compared to POPC-dominated regions. PSM molecules exhibit a measurable tilt and long-range tilt correlations within the lo domain as a consequence of the asymmetry of the bilayer, with implications to local membrane deformation and budding. Tagged particle diffusion for PSM and cholesterol molecules, which reflects spatial variations in the physical environment encountered by the tagged particle, is computed and compared with recent experimental results obtained from high-resolution microscopy[**Ve3**]

The molecular mechanism of ethanol and its effects on neurological function is far from clear. In this study, we investigate the effects of ethanol on various structural and dynamical properties of mixed bilayers consisting of different ratios of dipalmitoylphosphatidylcholine (DPPC), sphingomyelin (SM) and cholesterol that are typical constituents of neural cell membranes (Calderon et al., 1995) using molecular dynamics (MD) simulations. The bilayer properties such as thickness, hydrophobic chain order, and diffusive motion of individual lipids as well collective properties like lateral pressure profiles are affected by the presence of ethanol molecules. The simulations show that the percentage of cholesterol present in the bilayers significantly affects the depth of penetration of ethanol molecules. In particular, presence of very high concentration of cholesterol molecules enhances the rigidity of the bilayer and renders them resistant to the penetration of the ethanol molecules, consistent with experiments. Ethanol molecules compete with cholesterol molecules for hydrogen bonding and disrupt cholesterol-lipid interactions, especially those between SM and cholesterol. Ethanol molecules also affect the lateral pressure profiles in the bilayer systems. These results may have implications in understanding the general anesthetic mechanism and role played by cholesterol on partitioning of such anesthetic/alcohol molecules into cell membranes [**Ve2**]

Antimicrobial and hemolytic activities of amphiphilic random copolymers were modulated by the structure of the cationic side chain spacer arms, including 2-aminoethylene, 4-aminobutylene, and 6-aminohexylene groups. Cationic amphiphilic random copolymers with ethyl methacrylate (EMA) comonomer were prepared with a range of comonomer fractions, and the library of copolymers was screened for antimicrobial and hemolytic activities. Copolymers with 4-aminobutylene cationic side chains showed an order of magnitude enhancement in their antimicrobial activity relative to those with 2-aminoethylene spacer arms, without causing adverse hemolysis. When the spacer arms were further elongated to hexylene, the copolymers displayed potent antimicrobial and hemolytic activities. The 4-aminobutylene side chain appears to be the optimal spacer arm length for maximal antimicrobial potency and minimal hemolysis, when combined with hydrophobic ethylmethacrylate in a roughly 70/30 ratio. The copolymers displayed relatively rapid bactericidal kinetics and broad-spectrum activity against a panel of Gram-positive and Gram-negative bacteria. The effect of the spacer arms on the polymer conformation in the membrane-bound state was investigated by molecular dynamics simulations. The polymer backbones adopt an extended chain conformation, parallel to the membrane surface. A facially amphiphilic conformation at the membrane surface was observed, with the primary ammonium groups localized at the lipid phoshophate region and the nonpolar side chains of EMA comonomers buried in the hydrophobic membrane environment. This study demonstrates that the antimicrobial activity and molecular conformation of amphiphilic methacrylate random copolymers can be modulated by adjustment of cationic side chain spacer arms [**Ve1**]

**Classical and Quantum Gravity, Black Holes, Cosmology**

Loop Quantum gravity, at the kinematical level, is based on a uniquely selected but non-Schrodinger type Hilbert space. A toy version of this, in the context of finitely many degrees of freedom is known as *polymer quantization*. The implementation of continuous symmetries in such a Hilbert space leads to *dis-continuous* representations. These turn out to be not to be not viable physically and hence such symmetries must be broken explicitly or spontaneously. By going to a dual space, it is possible to recover continuous representation. These issues are discussed in [**D**].

A study of gravitational waves has also been initiated.

The first and the second laws of BH thermodynamics have already been shown to hold for the Lanczos-Lovelock theory.But the status of the zeroeth law in this theory was not clear so far. There are two independent versions of the zeroeth law. One states that the surface gravity is constant along any stationary Killing horizon if the matter satisfies the dominant energy condition, while according to the other version, the surface gravity is constant along the horizon of a static or stationary axi-symmetric black hole with the $t - \phi$ orthogonality property. The first version does not assume any other spacetime symmetry apart from stationarity, but impose a physical condition on matter, The second version is entirely geometric and holds regardless of what the field equations are.

In our work, we investigate whether using Lanczos-Lovelock field equations and suitable energy conditions, it is possible to prove the constancy of the surface gravity without assuming any extra symmetry of the spacetime. We found the answer to this question to be negative, i.e. surface gravity is not constant along a Killing horizon in general even if the matter source obeys the dominant energy condition.However, our result does not rule out the possibility that zeroeth law holds for Lanczos-Lovelock theories. Though it implies that the zeroeth law can only hold if all stationary black holes in Lanczos-Lovelock theories are axisymmetric with $t - \phi$ isometry. [**Sa**]

### Condensed Matter Physics

It is suggested that for a fermi gas at unitarity, the two-body bond plays a special role. Based on this, an ansatz for the equation of state, through virial expansion, is proposed relating the interaction part of the l-body cluster to its two-body counterpart. This allows a parameter-free comparison with the recently measured equation of state by the ENS and MIT groups and calculate the more sensitive thermodynamic parameters for temperatures above the superfluid transition temperature [**Mur1**]

In a recent preprint another form of the equation of state is examined in detail. The universal equation of state is parametrised in terms of Fermi-Dirac integrals. This reproduces the experimental data over the accessible range of fugacity and normalised temperature, but cannot describe the superfluid phase transition found in the MIT experiment. The most sensitive data for compressibility and specific heat at phase transition can, however, be fitted by introducing into the grand partition function a pair of complex conjugate zeros lying in the complex fugacity plane slightly off the real axis [**Mur2**].

In this work [**G2**], we are studying the decoherence and entanglement properties for the two site Bose-Hubbard model in presence of a non-linear damping. We apply the techniques of thermo field dynamics and then use Hartree-Fock approximation to solve the corresponding master equation. The expectation values of the approximated field is computed self-consistently. We solve this master equation for a small time $t$ so that we get the analytical solution, there by we compute the decoherence and entanglement properties of the two-mode bosonic system.

### CP-Violation, Neutrinos, B-Physics and New Models

Recent measurements of $\theta_{13}$ by Daya Bay and RENO reactor experiments have opened up the possibility of determining the neutrino mass hierarchy, i.e. the sign of the mass squared splitting $\Delta m^2_{31}$, the CP-violating phase $\delta_{CP}$ and the octant of $\theta_{23}$. In the light of this result, we studied the performance of a low energy neutrino factory (LENF) for determination of the mass hierarchy. In particular, we explored the potential of the $\nu_e$ and $\bar{\nu}_e$ disappearance channels at LENF to determine the neutrino mass hierarchy, that is free from the uncertainties arising from the unknown $\delta_{CP}$ phase and the $\theta_{23}$ octant. We found that using these electron neutrino (antineutrino) disappearance channels with a standard LENF, it is possible to exclude the wrong hierarchy at $5\sigma$ with only 2 years of running.[**N**]

1.Many astrophysical scenarios arising from the dark atoms formed by the stable massive charged particles proposed in the earlier work (arXiv:1105.5213[hep-ph]) are being studied. (G Rajasekaran, D Sahoo and S Sethi*, paper under preparation) 2.Unification of lepton and quark mixing under renormalization group evolution is examined in the context of the recent determination of the reactor neutrino angle. (G Abbas,S Gupta, G Rajasekaran and R Srivastava, Work in progress).

### Foundations of Quantum Mechanics

Hardy's nonlocality argument, which establishes incompatibility of quantum theory with local-realism, can also be used to reveal the time-nonlocal feature of quantum states. For spin-1/2 systems, the maximum probability of success of this argument is known to be 25 percent. We show [**G3**] that this maximum remains 25 percent for all finite-dimensional quantum systems with suitably chosen observables. This enables a test of the quantum properties of macroscopic systems in analogy to the method of Leggett and Garg.

Complementarity principle is one of the central concepts in quantum mechanics which restricts joint measurement for certain observables. Of course, later development shows that joint measure- ment could be possible for such observables with introduction of certain degree of unsharpness or fuzziness in the measurement. In this work [**G1**] we show that the optimal degree of unsharpness which guarantees the joint measurement of all possible pairs of dichotomic observables, determines the degree of nonlocality of quantum mechanics as well for more general no-signaling theories.

### Nonlinear Dynamics, Solitons and Chaos

Mean field dynamics of a hard-core boson system with nearest-neighbour interactions was investigated in our previous work (Phys. Rev. Lett. **103**, 230403 (2009)), and shown to support two distinct types of solitons in the continuum. One is of the Gross-Pitaevskii (GP) type, where the Bose-Einstein condensate is a dark soliton which dies at the speed of sound, and the other is a non-GP type which not only shows a brightening of the condensate soliton, but also survives at the speed of sound. In the present work, it is first shown that the evolution of the above mean field solitons remains stable on the discrete lattice as well. Next, the exact quantum evolution of the initial mean field profiles on the lattice, using adaptive time-dependent renormalization group method is presented. It is shown that both species of solitons are stable under quantum evolution for a finite duration, their tolerance to quantum fluctuations getting enhanced as the width of the soliton increases.[**Ba2**]

A gauge-invariant approach for associating a geometric phase with the phase space trajectory of a classical dynamical system is presented. As an application, the classical analog of the quantum Aharonov-Bohm Hamiltonian for a charged particle orbiting around a current-carrying long, thin solenoid is considered. The classical geometric phase of a closed trajectory is computed, and compared and contrasted with the well known quantum Aharonov-Bohm phase associated with the particle wave function of the Hamiltonian. In addition, a method to measure the classical geometric phase of the system using an appropriate optical fiber ring interferometer is suggested. [**Ba1**]

Dynamical patterns that arise in complex networks are often attributed to their non-trivial connection structure. However, the precise link between the fine topological structure of a network and the emergence of complex collective dynamics is unclear. To this end, the collective behavior of a system of globally coupled Wilson-Cowan (WC) oscillators has been investigated over a range of coupling strengths. The WC model is a simple representation of the dynamics in a local region of the brain comprising a cluster of excitatory and inhibitory neurons. The interaction of the pair of field variables corresponding to the fractions of active excitatory and active inhibitory neurons is seen to generate oscillations over a large region in the space of model parameters. In the course of this investigation, it has been found that a system of $N$ globally coupled oscillators can give rise to a rich variety of dynamical behavior. Patterns that resemble those seen with more realistic, sparser connectivity schemes can be reproduced in the globally coupled limit (which is effectively, a mean-field model) indicating that such complex behavior may be independent of the specific network architecture.

On the other hand, the precise topological structure of a network can strongly affect the functional significance of individual nodes. To investigate this in detail, a recently published database of connectivity pathways in the macaque brain has been used to reconstruct a modified network of connected brain areas. Mesoscopic structures in this network have been analyzed in order to identify those brain areas that play a significant role in the coordination of activity. For this purpose, the modular architecture of the network has first been identified. A new method for identifying functionally important nodes in a complex network based on their structural role (in terms of different types of betweenness centrality measures) has been proposed and applied to the network. Nodes corresponding to brain regions known to be involved in important functional tasks appear in the results, validating the analytical methods used.

A variety of complex spatial patterns relevant to chemical and biological systems can be generated through reaction-diffusionmechanisms. In work undertaken recently [**Sin1**] it has been shown that diffusive coupling through the inactivating component in a system of relaxation oscillators extends such complexity to the temporal domain, generating remarkable spatiotemporal phenomena. It is possible to analytically explain the genesis of antiphase synchronization and spatially patterned oscillatory death regimes seen in such systems. Chimera states are observed where patches with distinct dynamics coexist. In addition, propagating phase defects are seen that resemble persistent structures in cellular automata which may potentially be used for computation.

The heart is a fascinating example of nonlinear dynamics at work in biology. Alternans response, comprising a sequence of alternating long and short action potential durations in heart tissue, seen during rapid periodic pacing can lead to conduction block resulting in potentially fatal cardiac failure. A method of pacing with feedback control has been proposed to reduce the alternans and therefore the probability of subsequent cardiac failure [**Sinh6**]. The reduction is achieved by feedback control using small perturbations of constant magnitude to the original, alternans-generating pacing period $T$ , viz., using sequences of two alternating periods of $T + \Delta T$ and $T - \Delta T$ , with $\Delta T << T$. This alternans suppression scheme has been proposed and investigated in detail by simulations of ion-channel-based cardiac models both for a single cell and in one-dimensional spatially extended systems. Such a control scheme for alternans suppression has been verified experimentally in isolated whole heart experiments (in Academia Sinica, Taipei). The mechanism of the success of the proposed method can be understood in terms of dynamics in phase space, viz., as the state of activity of the cell being confined within a narrow volume of phase space for the duration of control, resulting in extremely diminished variation in successive action potential durations. The method is much more robust to noise than previous alternans reduction techniques based on fixed point stabilization and should thus be more efficient in terms of experimental implementation, which has implications for clinical treatment for arrhythmia.

**QFT, Topological QFT, Conformal Field Thoery**

The off-shell nilpotent and absolutely anti-commuting Becchi-Rouet-Stora-Tyutin (BRST) as well as anti-BRST symmetry transformations corresponding to the non-Yang-Mills symmetries of (2+1)-dimensional Jackiw-Pi model have been derived within the framework of augmented superfield formalism. It is shown that the Curci-Ferrari restriction, which is one of the hallmarks of non-Abelian one-form gauge theories, does not appear in this case. Furthermore, we have derived proper (anti-)BRST symmetry transformations corresponding to the auxiliary field $\rho$, that cannot be deduced by any conventional means. Finally, the standard BRST algebra have been established for this case. [**Gu**]

**Quantum Computations**

The traditional scheme for realizing open-system quantum dynamics takes the initial state of the system-bath composite as a simple product. Currently, however, the issue of system-bath initial correlations possibly affecting the reduced dynamics of the system has been attracting considerable interest. The influential work of Shabani and Lidar [PRL, vol. 102, 100402 (2009)] famously related this issue to quantum discord, a concept which has in recent years occupied the centre-stage of quantum information theory and has led to several fundamental results. They suggested that reduced dynamics is completely positive if and only if the initial system-bath correlations have vanishing quantum discord. Here we show [sibasish-2013.3] that there is, within the Shabani-Lidar framework, no scope for any distinguished role for quantum discord in respect of complete positivity of reduced dynamics. Since most applications of quantum theory to real systems rests on the traditional scheme, its robustness demonstrated here could be of far-reaching significance.

**Statistical Mechanics**

In recent times there has been a surge of interest in applying statistical mechanics to understand economic phenomena [**Sinh4**]. The recent worldwide economic crisis of 2007-09 has focused attention on the need to analyze systemic risk in complex financial networks. The problem of robustness of such systems has been studied recently in the context of the general theory of stability in complex networks [**Sinh5**]. In particular, the study looks at how the topology of connections influence the risk of the failure of a single institution triggering a cascade of successive collapses propagating through the network. Data on bilateral liabilities (or exposure) in the derivatives market between 202 financial intermediaries based in USA and Europe in the last quarter of 2009 is used to empirically investigate the structure of the inter-bank credit network. It is observed that the network exhibits both heterogeneity in node properties and the existence of communities. It also has a prominent core-periphery organization and can resist large-scale collapse when subjected to individual bank defaults (local perturbations) but is vulnerable to system-wide breakdown as a result of an accompanying liquidity crisis.

The concept of networks also extends to studying social phenomena. Science itsef, being a social enterprise, is subject to fragmentation into groups that focus on specialized areas or topics. Often new advances occur through cross-fertilization of ideas between sub-fields that otherwise have little overlap as they study dissimilar phenomena using different techniques. Thus to explore the nature and dynamics of scientific progress one needs to consider the organization and interactions between different subject areas. A study [**Sinh2**] has been undertaken to reveal the relationships between the different sub-fields of Physics using the Physics and Astronomy Classification Scheme (PACS) codes employed for self-categorization of articles published over the past 25 years (19852009). A clear trend is observed towards increasing interactions between the different sub-fields. The network of sub-fields also exhibits core-periphery organization, the nucleus being dominated by Condensed Matter and General Physics. However, over time Interdisciplinary Physics has steadily increased its share in the network core, reflecting a shift in the overall trend of Physics research.

Cooling granular media, characterized by inelastic collisions, exhibit varied physical phenomena. The shock formation and energy decay in a system where all particles are held stationary and one particle is given some energy was studied. A recent experiment on this topic was analyzed in detail. The exponents characterizing the growth of the radius of disturbance and decay of energy were determined exactly and the experimental data was shown to be consistent with this. All results were confirmed using extensive simulations on model systems [**P**].

Long rods interacting only through excluded volume interactions have been studied for a long time as models for liquid crystals. In the current study, the problem is studied on two dimensional lattices. A new Monte Carlo algorithm that does not suffer from slow-down due to jamming at high densities is proposed for studying such systems. Implementing this algorithm on a two dimensional square lattice, the existence of a transition from an ordered nematic phase to a disordered phase at high densities is shown. The effective exponents are different from the expected Ising universality class [**K**].

The large scale fluctuations of the ordered state in active matter systems are usually characterised by studying the giant number fluctuations of particles in any finite volume, as compared to the expectations from the central limit theorem. However, in ordering systems, the fluctuations in density ordering are often captured through their structure functions deviating from Porod law. The relationship between giant number fluctuations and structure functions, for different models of active matter as well as other non-equilibrium systems is studied. A unified picture emerges, with different models falling in four distinct classes depending on the nature of their structure functions [**Ra3**].

Can similary charged polymers aggregate together in the presence of oppositely charged monovalent counterions? Using large scale molecular dynamics simulations, it is demonstrated that monovalent counterions can induce aggregation of similarly charged rod-like polyelectrolyte chains. The critical value of the linear charge density for aggregation is shown to be close to the critical value for the extended–collapsed transition of a single flexible polyelectrolyte chain, and decreases with increasing valency of the counterions. The potential of mean force along the center of mass reaction coordinate between two similarly charged rod-like polyelectrolytes is shown to develop an attractive well for large linear charge densities [**V2**].

The large time behaviour of a system of aggregating particles in the presence of an input of monomers and removal of monomers is studied. For a broad class of collision rates, this system reaches a nonequilibrium stationary state at large times and the cluster size distribution tends to a universal form characterized by a constant flux of mass through the space of cluster sizes. Universality, in this context, means that the stationary state becomes independent of the cutoff as the cutoff grows. This universality is lost, however, if the aggregation rate between large and small clusters increases sufficiently steeply as a function of cluster sizes. A transition is identified to a regime in which the stationary state vanishes as the cutoff grows. This nonuniversal stationary state becomes unstable as the cutoff is increased. It undergoes a Hopf bifurcation after which the stationary state is replaced by persistent and periodic collective oscillations. These oscillations, which bear some similarities to relaxation oscillations in excitable media, carry pulses of mass through the space of cluster sizes such that the average mass flux through any cluster size remains constant. Universality is partially restored in the sense that the scaling of the period and amplitude of oscillation is inherited from the dynamical scaling exponents of the universal regime [**Ra1**].

A restricted solid on solid height growth model growing from a seed at the origin is studied using Monte Carlo simulations. It is shown that simple conjectures for the asymptotic shape of the surface cannot be right, and the correct result is more complicated [**Si**].

A d-dimensional lattice model of diffusing, coalescing massive particles, with two parameters controlling deposition and evaporation of monomers is studied. The unique stationary distribution for the system exhibits a phase transition in all dimensions greater than one between a growing phase, in which the expected mass is infinite at each site, and an exponential phase in which the expected mass is finite. Rigorous upper and lower bounds are established on the critical curve describing the phase transition for this system, and some asymptotics for large or small deposition rates [**Ra2**].

Thermodynamics and geometric properties of discrete symmetric spin systems

**String Theory**

This work, along with the early one more or less solves the problem of obtaining gauge invariant equations for open strings in a background independent formalism. In [**Sat1**] gauge invariant interacting equations were written down for the spin 2 and spin 3 massive modes using the exact renormalization group of a world sheet theory. This is generalized to all the higher levels in this paper. An interacting theory of an infinite tower of massive higher spins is obtained. They appear as a compactification of a massless theory in one higher dimension. The compactification and consequent mass is essential for writing the interaction terms. Just as for spin 2 and spin 3, the interactions are in terms of gauge invariant field strengths and the gauge transformations are the same as for the free theory. This theory can then be truncated in a gauge invariant way by removing one oscillator of the extra dimension to match the field content of BRST string (field) theory. The truncation has to be done level by level and results are given explicitly for level 4. At least up to level 5, the truncation can be done in a way that preserves the higher dimensional structure. There is a relatively straightforward generalization of this construction to (arbitrary) curved space time and this is also outlined.[**Sat2**]

In previous years an attempt has been made to describe non-linear sigma model (as relevant to string propagation in a curved background) using loop space language. One basic ingredient that goes into this formulation is an explicit Riemannian structure on loop space, given the same on the target space $M$. This can be obtained from a specific Riemannian structure on the tangent bundle $TM$ which is described as a tubular geometry around the zero section. It also turns out that the configuration space for the multi-particle bound state problem in curved space possesses a geometry that is related to this. In an ongoing work this tubular geometry is being worked out for a given $N$, the number of particles. At large $N$ the resulting geometry gives the tubular geometry of loop space around the submanifold of vanishing loops. This work therefore provides a regularization of infinite dimensional loop space geometry.

Gauged supergravity theories are of interest in string theory because of their connection to the low energy effective theory that describes string compactifications in the presence of fluxes. The theory supports AdS vaccum and describes the supergravity regime of the AdS/CFT correspondence. Given the importance of the attractor mechanism for black holes in supergravity, it is useful to pursue the generalisation to situations with AdS asymptotics. A specific approach for the generalisation of the attractor mechanism suitable for extremal black branes is considered. These generalised attractors are defined as solutions to equations of motion that reduce to algebraic equations, when all fields and curvature tensor components are constants in tangent space. The attractor geometries are characterised by constant anholonomy coefficients and include planar solutions such as black branes and domain walls.

Generalised attractors in five dimensional N=2 gauged supergravity theories coupled to arbitrary number of vector, hyper and tensor multiplets are studied. The equations of motion of the theory are analysed and an attractor potential is obtained from the scalar field equations. It is further shown that the attractor potential can be independently constructed from generalised fermionic shifts. The generalised attractors in five dimensional gauged supergravity include near horizon geometries of extremal black branes with homogeneity in spatial directions (Bianchi Attractors). A simple gauged supergravity model with one vector multiplet is considered and explicit examples of Bianchi attractors were constructed [**I**].

### 2.2.2 List of Publications

The list of publications follows the following conventions: firstly, names of (co)authors who are not IMSc members are marked with a superscript *; secondly, the citation labels used for cross-referencing with the research summary are constructed from the last name of the first IMSc author and finally the list is ordered alphabetically according to the labels.


[**A1**]
**Assa S. Aravindh**.
Chapter.16. recent developments in density functional theory(dft) studies on magnetic nanowires.
In *NANOTECHNOLOGY Vol.3: Synthesis and Characterization*, page 397. Studium Press LLC P.O. Box 722 200, Houston, TX,77072 - USA, 2013.

[**A2**]
**Assa S. Aravindh**.
Studies of femirn nano clusters using density functional theory techniques.
2013.
(Preprint: arXiv:1301.5150v1).

[**B1**]
**M. Asorey*, A. P. Balachandran, G. Marmo*, I.P. Costa e Silva*, A.R. de Queiroz*, P. Teotonio-Sobrinho*, and S. Vaidya***.
Quantum physics and fluctuating topologies: a survey.
Nov. 2012.
(eprint: arXiv:1211.6882 [hep-th] ).

[**B2**]
**A. P. Balachandran, A.R. de Queiroz*, and S. Vaidya***.
Entropy of quantum states: Ambiguities.
2012.
(eprint: arXiv:1212.1239).

[**B3**]
**A. P. Balachandran and S. Vaidya***.
Spontaneous lorentz violation in gauge theories.
2012.
(eprint: arXiv:1302.3406).

[**Ba1**]
**Radha Balakrishnan and Indubala I. Satija***.
Geometric phase of a classical Aharonov-Bohm Hamiltonian system.
*Physics Letters A*, 2013.
(To be published).

[**Ba2**]
**Chester P. Rubbo*, Indubala I. Satija*, W P. Reinhardt*, Radha Balakrishnan, Ana Maria Rey*, and S. R. Manmana***.
Quantum dynamics of solitons in strongly interacting systems on optical lattices.
*Phys. Rev. A*, **85**, 053617, 2012.

[**D**]
**Ghanashyam Date and Nirmalya Kajuri**.
Polymer quantization and symmetries.
*Class. Quantum Grav.*, **30**, 075010, 2013.

[**G1**]
**Manik Banik*, MD. Rajjak Gazi*, Sibasish Ghosh, and Guruprasad Kar***.
Complementarity principle determines the degree of bell violation in quantum mechanics.
*Phys. Rev. A*, 2012.
arXiv:1206.6054 (quant-ph) (To be published).

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Entanglement in two site bose-hubbard model.
2013.
(Preprint: arXiv:1302.5238 (quant-ph)).

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Persistence of hardy's nonlocality in time.
2013.
(Preprint: arXiv:1302.5296 (quant-ph)).

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**Sandeep K. Goyal***, **Patricia E. Boukama-Dzoussi***, **Sibasish Ghosh**, **Filippus S. Roux***, **and Thomas Konrad***.
Qudit-teleportation for photons with linear optics.
2012.
(Preprint: arXiv:1212.5115 (quant-ph)).

[**Gu**]
**Saurabh Gupta and R. Kumar***.
Augmented superfield approach to non-Yang-Mills symmetries of Jackiw-Pi model: Novel observations.
*Modern Physics Letters A*, **28(6)**, 1350011, 2013.

[**I**]
**Karthik Inbasekar and Prasanta K. Tripathy***.
Generalized attractors in five-dimensional gauged supergravity.
*Journal of High Energy Physics*, **2012(09)**, 003, 2012.

[**K**]
**Joyjit Kundu**, **R. Rajesh**, **Deepak Dhar***, **and Jurgen Stilck***.
The nematic-disordered phase transition in systems of long rigid rods on two dimensional lattices.
*Phys. Rev. E*, **87**, 032103, 2013.

[**M1**]
**Somshubhro Bandyopadhyay* and Prabha Mandayam**.
Operational measure of incompatibility of noncommuting observables.
*Physical Review A*, **87(4)**, 042120, 2013.

[**M2**]
**Prabha Mandayam**, **Somshubhro Bandyopadhyay***, **Markus Grassl***, **and William Wootters***.
Unextendible mutually unbiased bases from pauli classes.
*Physical Review A*, 2013.
1302.3709 (Submitted).

[**M3**]
**Prabha Mandayam and Hui Khoon Ng***.
Towards a unified framework for approximate quantum error correction.
*Physical Review A*, **86(1)**, 012335, 2012.

[**Mu**]
**Partha Mukhopadhyay**.
Towards a loop space description of non-linear sigma model.
In Elias Vagenas Theocharis Kosmas and Dimitrios Vlachos, editors, *IC-MSQUARE 2012: International Conference on Mathematical Modelling in Physical Sciences*, page 012132. Journal of Physics: Conference Series, Feb 2013.

[**Mur1**]
**R. Bhaduri***, **W. van Dijk***, **and M. Murthy**.
Universal equation of state of a unitary fermionic gas.
*Physical Review Letters*, **108**, 260402, 2012.

[**Mur2**]
**M. Murthy, M. Brack***, **and R. Bhaduri***.
A phenomenological approach to the equation of state of a unitary fermi gas.
2013.
(Preprint: arXiv:1302.6316 [cond-mat]).

[**N**]
**Rupak Dutta***, **Nita Sinha, and Sushant K. Raut***.
Determining neutrino mass hierarchy from electron disappearance at a low energy neutrino factory.
*Physical Review D*, 2012.
arXiv:1210.6479 [hep-ph] (Submitted).

[**P**]
**S. N. Pathak, Z. Jabeen***, **P. Ray, and R. Rajesh**.
Shock propagation in granular flow subjected to an external impact.
*Physical Review E*, **85**, 061301, 2012.

[**R1**]
**G. Rajasekaran**.
Standard model, higgs boson and what next?
*Resonance (Journal of Science Education)*, **17(10)**, 956, 2012.

[**R2**]
**G. Rajasekaran**.
Manpower for fundamental physics experiments.
*Current Science*, **103(1)**, 19, 2012.

[**R3**]
**G. Rajasekaran**.
High energy physics in 2012.
*Current Science*, **103(3)**, 250, 2012.

[**R4**]
**G. Rajasekaran**.

An angle to tackle the neutrinos.
*Current Science*, **103(6)**, 622, 2012.

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*Phys. Rev. Lett.*, **109**, 168304, 2012.

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**C. Connaughton***, **R. Rajesh, R. Tribe***, **and O. Zaboronski***.
Non-equilibrium phase diagram for a model with coalescence, evaporation and deposition.
*Commun. Math. Phys.*, 2012.
arXiv:1211.3576 (Submitted).

[**Ra3**]
**S. Dey***, **D. Das***, **and R. Rajesh**.
Spatial structures and giant number fluctuations in models of active matter.
*Phys. Rev. Lett.*, **108**, 238001, 2012.

[**S**]
**Krishna K. Sabapathy, J. I. Solomon***, **Sibasish Ghosh, and R. Simon**.
Quantum discord plays no distinguished role in characterization of complete positivity: Robustness of the traditional scheme.
2013.
(Preprint: arXiv:1304.4857 (quant-ph)).

[**Sa**]
**Sudipta Sarkar and Swastik Bhattacharya**.
The issue of zeroth law for killing horizons in lanczos-lovelock gravity.
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**Balachandran Sathiapalan**.
Loop variables and gauge invariant exact renormalization group equations for (open) string theory.
*Nuclear Physics B*, **862(1)**, 43, 2012.

[**Sat2**]
**Balachandran Sathiapalan**.
Loop variables and gauge invariant exact renormalization group equations for (open) string theory -ii.
*Nuclear Physics B*, **868(1)**, 16, 2013.

[**Si**]
**R. Singh and R. Rajesh**.

Comment on “Growth inside a corner: The limiting interface shape”.
*Phys. Rev. Lett.*, **109**, 259601, 2012.

[**Sin1**]
**Rajeev Singh and Sitabhra Sinha**.
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*Physical Review E*, **87(1)**, 012907, 2013.

[**Sin2**]
**Jinshan Xu***, **Rajeev Singh, Nicolas Garnier***, **Sitabhra Sinha, and Alain Pumir***.
Large variability in dynamical transitions in biological systems with quenched disorder.
2012.
arXiv:1212.3466 (Submitted).

[**Sinh1**]
**T. Jesan***, **Uddipan Sarma***, **Subhadra Halder***, **Bhaskar Saha***, **and Sitabhra Sinha**.
Branched motifs enable long-range interactions in signaling networks through retrograde propagation.
*PLOS ONE*, 8, 2013.
(To be published).

[**Sinh2**]
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*Scientific Reports*, **2**, 551, 2012.

[**Sinh3**]
**Uddipan Sarma***, **Archana Sareen***, **Moitrayee Maiti***, **Vanita Kamat***, **Raki Sudan***, **Sushmita Pahari***, **Neetu Srivastava***, **Somenath Roy***, **Sitabhra Sinha, Indira Ghosh***, **Ajit G. Chande***, **Robin Mukhopadhyaya***, **and Bhaskar Saha***.
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[**Sinh6**]
**S. Sridhar***, **D-M Le***, **Y-C Mi***, **Sitabhra Sinha, P-Y Li***, **and C. K. Chan***.
Suppression of cardiac alternans by alternating-period-feedback stimulations.
*Physical Review E*, 87, 2013.
(To be published).

[**V1**]
**Anoop Varghese, Satyavani Vemparala, and Rajesh Ravindran**.
Phase transitions of a single polyelectrolyte chain in a poor solvent with multivalent counterions.
In *Solid State Physics: proceedings of the 56th DAE Solid State Physics Symposium 2011*, page 129. AIP, May 2012.

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Cationic spacer arm design strategy for control of antimicrobial activity and conformation of amphiphilic methacrylate random copolymers.
*Biomacromolecules*, **13**, 1632, 2012.

[**Ve2**]
**Anirban Polley*** **and Satyavani Vemparala**.
Partitioning of ethanol in multi-component membranes: effects on membrane structure.
*Chemistry and Physics of Lipids*, **166**, 1, 2013.

[**Ve3**]
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Atomistic simulations of a multicomponent asymmetric lipid bilayer.
*Journal of Physical Chemistry B*, **116**, 13403, 2012.

## 2.3 Theoretical Computer Science

### 2.3.1 Research Summary

#### Algorithms and Data Structures

An undirected graph is said to be *split* if its vertex set can be partitioned into two sets such that the subgraph induced on one of them is a complete graph and the subgraph induced on the other is an independent set.The problem of deleting the minimum number of vertices or edges from a given input graph so that the resulting graph is split is studied in [**G**]. A systematic study is initiated and efficient fixed-parameter algorithms and polynomial sized kernels for the problem are given. More precisely,

1. for Split Vertex Deletion, the problem of determining whether there are $k$ vertices whose deletion results in a split graph, an $\mathcal{O}^*(2^k)$[1] algorithm improving on the previous best bound of $\mathcal{O}^*(2.32^k)$ is given. An $\mathcal{O}(k^3)$-sized kernel for the problem is also given.

2. For Split Edge Deletion , the problem of determining whether there are $k$ edges whose deletion results in a split graph, an $\mathcal{O}^*(2^{O(\sqrt{k}\log k)})$ algorithm is given. The existence of an $\mathcal{O}(k^2)$ kernel is also proved.

In addition, the algorithm for Split Edge Deletion adds to the small number of subexponential parameterized algorithms not obtained through bidimensionality, and on general graphs.

The work in [**R**] explores the applications of co-nondeterminism for showing kernelization lower bounds. The only known example excludes polynomial kernelizations for the Ramsey problem of finding an independent set or a clique of at least $k$ vertices in a given graph (Kratsch 2012, SODA). The more general problem of finding induced subgraphs on $k$ vertices fulfilling some hereditary property $\Pi$ is studied. The problem is NP-hard for all non-trivial choices of $\Pi$ by a classic result of Lewis and Yannakakis (JCSS 1980). The parameterized complexity of this problem was classified by Khot and Raman (TCS 2002) depending on the choice of $\Pi$. The interesting cases for kernelization are for $\Pi$ containing all independent sets and all cliques, since the problem is trivial or W[1]-hard otherwise. The results in the paper are twofold. Regarding $\Pi$-Induced Subgraph, it is shown that for a large choice of natural graph properties $\Pi$, including chordal, perfect, cluster, and cograph, there is no polynomial kernel with respect to $k$. This is established by two theorems: one using a co-nondeterministic variant of cross-composition and one by a polynomial parameter transformation from Ramsey.

Several NP-hard problems, like Maximum Independent Set, Coloring, and Max-Cut are polynomial time solvable on bipartite graphs. An equivalent characterization of bipartite graphs is that it is the set of all graphs that do not contain any odd length cycle. Thus, a natural question here is what happens to the complexity of these problems if we know that the length of the longest odd cycle is bounded by $k$? Let $\mathcal{O}_k$ denote the set of all graphs $G$ such that the length of the longest odd cycle is upper bounded by $k$. Hsu, Ikura and Nemhauser [*Math. Programming*, 1981] studied the effect of avoiding long odd cycle for the Maximum Independent Set problem and showed that a maximum sized independent set on a graph $G \in \mathcal{O}_k$ on $n$ vertices can be found in time $n^{O(k)}$. Later, Grötschel and Nemhauser [*Math. Programming*, 1984] did a similar study for Max-Cut and obtained an algorithm with running time $n^{O(k)}$ on a graph $G \in \mathcal{O}_k$ on $n$ vertices. In the paper [**P**], these problems together with $q$-Coloring are revisited and it is observed that all of these problems admit algorithms with running time $O(c^k n^{O(1)})$ on a graph $G \in \mathcal{O}_k$ on $n$ vertices. Thus, showing that all these problems are fixed parameter tractable when parameterized by the length of the longest odd cycle of the input graph. The kernelization complexity of these problems are also studied and it is shown that Maximum Independent Set, $q$-Coloring for some fixed $q \geq 3$ and Max-Cut do not admit a polynomial kernel unless co-NP $\subseteq$ NP/poly, when parameterized by $k$, the length of the longest odd cycle.

[1] $\mathcal{O}^*()$ notation hides factors that are polynomial in the input size.

### Automata, Logic and Concurrency

In the study of automata over infinite alphabets, [**Ra3**] proposes a class of automata that are in between register automata and class memory automata in terms of expressive power, and have elementary decidability of emptiness checking. Work continues on developing a structure theory of strategies in extensive form games, in which players are bounded memory agents [**Ra2**, **Ra1**].

A research work on fuzzy interval-valued semantics for graded consequence is ongoing

A work on a parallel version of AGM postulates for belief revision in the context of graded consequence is ongoing.

In the paper [**Du6**] Fuzzy Logic a la Pavelka has been reintroduced in terms of consequence relation instead of consequence operator. Metalogical notions like, consistency and inconsistency are pro- posed as graded notions. The relationship between consequence relation and inconsistency, both fuzzy here, is studied. Another metalogical notion viz., equivalence of two sets of formulae that originates from Tarski is defined and investigated in this context when the premise is a fuzzy set.

The extended abstract [**Du3**] contains an idea of proof theory in the context of graded consequence. This study makes it explicit that in one hand, the presence of a particular rule concerning a particular connective induces some interrelations between the algebraic interpretation of the object level and meta level of a logic, and on the other, algebraic structures presumed for both the levels of a logic determine the availability of rules in the logic.

In [**Du4**] two sets of axiomatizations are proposed for consequence and inconsistency of paraconsistent logics where an operator, may be called complementation operator, is taken under consideration instead of the object language connective negation.

In this paper [**Du2**], a comparative study of many-valued logics, fuzzy logics and the theory of graded consequence has been made fo- cussing on consequence, inconsistency and sorites paradox.

The content of [**Du1**] is a study of the properties of the algebraic structure which can be considered as the model for the graded version of classical conditions viz., overlap, dilution, cut, law of explosiveness and reasoning by cases.

In [**Du5**] concepts like fuzzy homorelation, correlation, cohomorelation, fuzzy function and fuzzy morphism are introduced and discussed. The difference from the existing approaches lies in its uniform and integrated way of developing the concepts in the context of fuzzy sets keeping parity with that of classical case.

### Computational Complexity

In the paper [**M3**], the study of proof systems where verification of proofs proceeds by $\mathrm{NC}^0$ circuits is initiated. The question of which languages admit proof systems in this very restricted model (or formulated alternatively, which languages can be enumerated by $\mathrm{NC}^0$ functions) is investigated. The study shows that the answer to this problem is not determined by the complexity of the language. On the one hand, $\mathrm{NC}^0$ proof systems for a variety of languages ranging from regular to NP-complete are constructed. On the other hand, by combinatorial methods it is shown that even easy regular languages such as Exact-OR do not admit $NC^0$ proof systems. It is also shown that Majority does not admit $NC^0$ proof systems. Finally, a general construction of $NC^0$ proof systems for regular languages with strongly connected NFA's is presented.

In the paper [**M2**], the problem of testing if the polynomial computed by an arithmetic circuit is identically zero (ACIT) is studied. A deterministic polynomial time algorithm for this problem when the inputs are read-twice formulas is given. This algorithm also computes the MLIN predicate, testing if the input circuit computes a multilinear polynomial. Further, two related computational problems on arithmetic circuits are studied. Given an arithmetic circuit $C$, 1) ZMC: test if a given monomial in $C$ has zero coefficient or not, and 2) MONCOUNT: compute the number of monomials in $C$. (These problems were introduced by Fournier, Malod and Mengel [STACS 2012], and shown to characterize various levels of the counting hierarchy (CH).) The above problems are addressed on read-restricted arithmetic circuits and branching programs. Several complexity characterizations for the above problems on these restricted classes of arithmetic circuits are obtained.

Given a stream of $n$ numbers and a number $B$, the subset sum problem deals with checking whether there exists a subset of the stream that adds to exactly $B$. The unary subset sum problem, USS, is the same problem when the input is encoded in unary. In the paper [**M1**], it is proved that any $p$-pass randomized algorithm computing USS with error at most 1/3 must use space $\Omega(\frac{B}{p})$. For $p \leq B$, a randomized $p$-pass algorithm that computes USS with error at most 1/3 using space $\tilde{O}(\frac{nB}{p})$ is given. A deterministic one-pass algorithm which given an input stream and two parameters $B, \epsilon$, decides whether there exist a subset of the input stream that adds to a value in the range $[(1-\epsilon)B, (1+\epsilon)B]$ using space $O\left(\frac{\log B}{\epsilon}\right)$ is also given. It is observed that USS is monotone (under a suitable encoding), and a monotone $NC^2$ circuit for USS is given. It is also shown that any circuit using $\varepsilon$-approximator gates for USS under this encoding needs $\Omega(n/\log n)$ gates to compute the Disjointness function.

In the uniform circuit model of computation, the width of a boolean circuit exactly characterizes the "space" complexity of the computed function. Looking for a similar relationship in Valiant's algebraic model of computation, in the paper [**M4**], width of an arithmetic circuit is proposed as a possible measure of space. In the uniform setting, it is shown that this definition coincides with that of VPSPACE at polynomial width. The class VLOG is introduced as an algebraic variant of deterministic log-space LOG; VLOG is a subclass of VP.

Further, to define algebraic variants of non-deterministic space-bounded classes, the notion of "read-once" certificates for arithmetic circuits is introduced. It is shown that polynomial-size algebraic branching programs (an algebraic analogue of NL) can be expressed as read-once exponential sums over polynomials in VLOG, i.e. VBP $\in \Sigma^R \cdot$ VLOG. Thus read-once exponential sums can be viewed as a reasonable way of capturing space-bounded non-determinism. It is also shown that $\Sigma^R \cdot$ VBP = VBP, i.e. VBPs are stable under read-once exponential sums.

Though the best upper bound obtained for $\Sigma^R \cdot$ VLOG itself is VNP, better upper bounds for width-bounded multiplicatively disjoint (MD) circuits can be obtained. Without the width restriction, MD arithmetic circuits are known to capture all of VP. It is shown that read-once exponential sums over MD constant-width arithmetic circuits are within VP, and that read-once exponential sums over MD polylog-width arithmetic circuits are within VQP.

Finally, it is also shown that exponential sums of a skew formula cannot represent the determinant polynomial. These results are reported in the paper [**M4**].

**Graph Theory and Combinatorics**

In an ongoing work, the problem of producing, given a bipartite graph revealed vertex by vertex in an online fashion, a random matching which saturates all vertices of one partite set and which also obeys some specified marginal distributions and correlation properties, was studied and an efficient algorithm has been designed for this problem.

In an ongoing work, the concentration of the sizes of largest induced paths, trees and cycles (holes) was studied in the random graph model . A 2-point concentration is proved for the size of the largest induced path and cycle, for all $p \geq n^{-1/2}(\ln n)^2$. As a corollary, an improvement is obtained over a 25-year old result of Erdős and Palka [**?**]concerning the size of the largest induced tree in a random graph. Further, the concentration of the associated chromatic numbers are also being studied.

The strong chromatic index of a graph is the minimum number of colours with which the edges of a graph can be coloured such that each colour class is an induced matching in the graph. An almost tight upper bound of $3\Delta + 3$ was shown for the strong chromatic index of chordless graphs, which are graphs in which there is no cycle with a chord. (Joint work with Manu Basavaraju, manuscript in preparation).

Given a collection of sets of elements from a universe, we say that a subcollection is a "test cover" if for every pair u,v in the universe, there is a set in the collection that contains one of them but not the other. If the universe has n elements, there always exists a test cover of size at most n-1 if the initial collection contains some test cover. It is known that there is an FPT algorithm with k as the parameter that decides whether there exists a test cover of size (n-k) in a given collection. We show a partial polynomial kernel for this problem. (Project still ongoing)

### 2.3.2 List of Publications

The list of publications follows the following conventions: firstly, names of (co)authors who are not IMSc members are marked with a superscript $^*$; secondly, the citation labels used for cross-referencing with the research summary are constructed from the last name of the first IMSc author and finally the list is ordered alphabetically according to the labels.

[**D**]
**Kunal Dutta, Dhruv Mubayi*, and C. R. Subramanian**.
New lower bounds for the independence number of sparse graphs and hypergraphs.
*SIAM Journal on Discrete Mathematics*, **26(3)**, 1134–1147, 2012.

[**Du1**]
**Soma Dutta**.

Algebra of negation fragment of a logic with graded notion of consequence.
In *2nd International Conference on Rough sets, Fuzzy Sets and Soft Computing (ICRFSC12)*, Dec 2012.
(To be published).

[**Du2**]
**Soma Dutta, Sanjukta Basu***, **and Mihir K. Chakraborty***.
Many-valued logics, fuzzy logics and graded consequence: A comparative appraisal.
In Kamal Lodaya, editor, *ICLA2013*, page 197. Springer, Jan 2013.

[**Du3**]
**Soma Dutta and Mihir K. Chakraborty***.
Proof theory for the theory of graded consequence.
In Alexandre Costa-Leite Jean-Yves Beziau, Arthur Buchsbaum, editor, *4th World Congress and School on Universal LOgic (UNILOG2013)*, page 283, Mar 2013.

[**Du4**]
**Soma Dutta and Mihir K. Chakraborty***.
Paraconsistency and a complementation operator.
In Alexandre Costa-Leite Jean-Yves Beziau, Arthur Buchsbaum, editor, *4th World Congress and School on Universal Logic (UNILOG2013)*, page 325, Mar 2013.

[**Du5**]
**Soma Dutta and Mihir K. Chakraborty***.
Fuzzy relation and fuzzy function over fuzzy sets: a retrospective.
*Soft Computing*, 2012.
(Submitted).

[**Du6**]
**Soma Dutta and Mihir K. Chakraborty***.
Graded consequence with fuzzy set of premises.
*Fundamenta Informaticae*, 2013.
(To be published).

[**F**]
**Mathew C. Francis, Pavol Hell***, **and Juraj Stacho***.
Obstructions to chordal circular-arc graphs of small independence number.
In *LAGOS 2013*. Electronic Notes in Discrete Mathematics (Elsevier), Jan 2013.
(To be published).

[**G**]
**Esha Ghosh, Sudeshna Kolay, Mrinal Kumar***, **Pranabendu Misra, Fahad Panolan, Ashutosh Rai, and M. S. Ramanujan**.
Faster parameterized algorithms for deletion to split graphs.
In Fedor V. Fomin and Petteri Kaski, editors, *Scandinavian Symposium and Workshops on Algorithm Theory (SWAT) 2012*, pages 107–118. Springer, Jul 2012.

[**L**]
**Kamal Lodaya**.
A language-theoretic view of verification.
In Deepak D'Souza and Priti Shankar, editors, *Modern applications of automata theory*, pages 149–169. World Scientific, 2012.

[**M1**]
**Nutan Limaye***, **Meena Mahajan, and Karteek Sreenivasaiah**.
The complexity of unary subset sum.
In *COCOON 2012, LNCS Vol 7434*, pages 458–469. Springer, Aug 2012.

[**M2**]
**Meena Mahajan, B V Raghavendra Rao***, **and Karteek Sreenivasaiah**.
Identity testing, multilinearity testing, and monomials in read-once/twice formulas and branching programs.
In *37th International Symposium on Mathematical Foundations of Computer Science MFCS. LNCS 7464*, pages 655–667. Springer, Aug 2012.

[**M3**]
**Olaf Beyersdorff***, **Samir Datta***, **Andreas Krebs***, **Meena Mahajan,** * **Gido Scharfenberger-Fabian, Karteek Sreenivasaiah, Michael Thomas***, **and Heribert Vollmer***.
Verifying proofs in constant depth.
*ACM Transactions on Computation Theory*, 2013.
(To be published).

[**M4**]
**Meena Mahajan and B. V. Raghavendra Rao***.
Small-space analogues of Valiant's classes and the limitations of skew formulas.
*Computational Complexity*, **22(1)**, 1–38, 2013.

[**P**]
**Fahad Panolan and Ashutosh Rai**.
On the kernelization complexity of problems on graphs without long odd cycles.
In Joachim Gudmundsson, Julián Mestre, and Taso Viglas, editors, *Computing and Combinatorics - 18th Annual International Conference, COCOON 2012, Sydney, Australia, August 20-22, 2012. Proceedings*, pages 445–457. Springer, Aug 2012.
(Submitted).

[**R**]
**Stefan Kratsch***, **Marcin Pilipczuk***, **Ashutosh Rai, and Venkatesh Raman**.
Kernel lower bounds using co-nondeterminism: Finding induced hereditary subgraphs.
In Fedor V. Fomin and Petteri Kaski, editors, *Scandinavian Symposium and Workshops on Algorithm Theory (SWAT) 2012*, pages 364–375. Springer, Jul 2012.

[**Ra1**]
**Sujata Ghosh*** **and R. Ramanujam**.

Strategies in games: A logic-automata study.
In Bezanishvili and Goranko, editors, *Lectures on Logic and Computation, LNCS 7388*, page 116. Springer, 2012.

[**Ra2**]
**Sujata Ghosh***, **R. Ramanujam, and Sunil Simon***.
Parallel composition on extensive form games.
In Marcoci Baltag, Grossi and Smets, editors, *Logic and interactive rationality, Yearbook 2011*, page 214. Amsterdam University Press, 2012.

[**Ra3**]
**Amaldev Manuel*** **and R. Ramanujam**.
Automata over infinite alphabets.
In D'Souza and Shankar, editors, *Modern Applications of Automata Theory*, page 529. World Scientific, 2012.

[**Ram1**]
**Robert Crowston***, **Gregory Gutin***, **Mark Jones***, **Venkatesh Raman, and Saket Saurabh**.
Parameterized complexity of maxsat above average.
In Davind Fernandez-Baca, editor, *10th Latin American Symposium (LATIN 2012)*, pages 184–194. Springer Verlag, Apr 2012.

[**Ram2**]
**Robert Crowston***, **Gregory Gutin***, **Mark Jones***, **Venkatesh Raman, Saket Saurabh, and Anders Yeo***.
Fixed parameter tractability of satisfying beyond the number of variables.
In Alessandro Cimatti and Roberto Sebastiani, editors, *15th International Conference on Theory and Applications of Satisfiability Testing*, page 355. Springer Verlag, Jun 2012.

[**Ram3**]
**Venkatesh Raman and Balsri Shankar**.
Improved fixed-parameter algorithm for the minimum weight 3-sat problem.
In Subir Kumar Ghosh and Takeshi Tokuyama, editors, *Seventh International Workshop on Algorithms and Computation*, page 265. Springer Verlag, Feb 2013.

[**Ram4**]
**Venkatesh Raman, Saket Saurabh, and Ondrej Suchy***.
An fpt algorithm for tree deletion set.
In Subir Kumar Ghosh and Takeshi Tokuyama, editors, *Seventh International Workshop on Algorithms and Computation*, page 286. Springer Verlag, Feb 2013.

[**Ram5**]
**Fedor V. Fomin***, **Daniel Lokshtanov***, **B.V. R. Rao***, **Venkatesh Raman, and Saket Saurabh**.
Faster algorithms for finding and counting subgraphs.
*Journal of Computer and System Sciences*, **78(3)**, 698, 2012.

[**S1**]
**N. R. Aravind*** **and C. R. Subramanian**.
Forbidden subgraph colorings and the oriented chromatic number.
*European Journal of Combinatorics*, **34(3)**, 620–631, 2013.
(Submitted).

[**S2**]
**T. Karthick*** **and C. R. Subramanian**.
Star coloring subcubic graphs.
*Discussiones Mathematicae Graph Theory*, **33(2)**, 373–385, 2013.

## Books/Monographs Authored/Edited

The list below follows the same conventions as those followed for the list of publications.

[**L**]
Kamal Lodaya, editor.
*Proc 5th Indian conference on logic and applications*, volume 7750 of *LNCS*.
Springer, 2013.

## 2.4 Student Programmes

### 2.4.1 Degrees Awarded

**Theoretical Computer Science**

Name: **Sheerazuddin, S.**
Thesis Title: Temporal specification of client server systems and unbounded agents
Thesis Advisor: Ramanujam, R.
University: HBNI

**Doctoral Theses Submitted during 2012 – 2013**

**Mathematics**

Name: **Paul, Pampa**
Thesis Title: $L_0$ types common to a Borel-de Siebenthal discrete series and its associated holomorphic discrete series.
Thesis Advisor: Sankaran, Parameswaran
University: HBNI

Name: **Venkatesh, R.**
Thesis Title: Unique Factorization Of Tensor Products For Kac-Moody Algebras.
Thesis Advisor: Viswanath, Sankaran
University: HBNI

Name: **Krishnan, Rajkumar**
Thesis Title: Zeros of general $L$-functions on the critical line
Thesis Advisor: Srinivas, K.
University: HBNI

Name: **Sharma, Sachin S.**
Thesis Title: The t-analogue of string functions for the affine Kac-Moody algebras.
Thesis Advisor: Viswanath, Sankaran
University: HBNI

Name: **Mubeena, T.**
Thesis Title: Twisted conjugacy classes in lattices in semisimple Lie groups.
Thesis Advisor: Sankaran, Parameswaran
University: HBNI

Name: **Prem Prakash Pandey**
Thesis Title: Some Problems in Number Theory
Thesis Advisor: Balasubramanian, R.
University: HBNI

Name: **Chatterjee, Tapas**
Thesis Title: Periodic Dirichlet series and Transcendence
Thesis Advisor: Gun, S.
University: HBNI

**Physics**

Name: **Varghese, Annop**
Thesis Title: Phase Transitions in Polyelectrolyte Systems
Thesis Advisor(s): Rajesh, R. & Vemparala, Satyavani
University: HBNI

**Masters Theses during 2012 – 2013**

**Mathematics**

Name: **Mahatab, Kamalakshya**
Thesis Title: Geometry of Linear Diophantine equations
Thesis Advisor: Prasad, Amritanshu
University:HBNI

**Physics**

Name: **Sharan, Gola G.**
Thesis Title: Locally Accessible Classical Information in Quantum Information Theory
Thesis Advisor: Ghosh, Sibasish
University: HBNI

Name: **Kunjwal, Ravi**
Thesis Title: Limits on Nonlocal Correlations from Physical Principles
Thesis Advisor: Ghosh, Sibasish
University: HBNI

Name: **Biswas, Aritra**
Thesis Title: CP Violation in the Charm Sector
Thesis Advisor: Sinha, Nita
University: HBNI

Name: **Shingnaisui, Chihanso**
Thesis Title: Dark Matter and Sterile Neutrinos-a minireview
Thesis Advisor: Sinha, Nita
University: University of Madras

Name: **Ravindran, Krishnakumar**

Thesis Title: Dark Matter and Flavour-a minireview
Thesis Advisor: Sinha, Nita
University: University of Madras

Name: **Roy, Subhadeep**
Thesis Title: Ductile-Brittle Transition : a Statistical Mechanical Approach
Thesis Advisor: Ray, Purusattam
University: HBNI

**Theoretical Computer Science**

Name: **Saurabh, Nitin**
Thesis Title: Algebraic Models of Computation
Thesis Advisor: Mahajan, Meena B.
University: HBNI

### 2.4.2 Lecture Courses During 2012 – 2013.

The following **lecture courses** were offered during 2012 – 2013.

| Course Title | Period | Lecturer |
|---|---|---|
| **Mathematics** | | |
| Elliptic curve cryptology | Jan-Apr 2012 | Balasubramanian, R. |
| A course in Analytic Number Theory | Jan-Apr 2012 | Balasubramanian, R. |
| Algebraic Number Theory | Jan-Apr 2012 | Srinivas, K. |
| Elliptic Curves | Jan-Apr 2012 | Gun, S. |
| Topology-II | Jan-Apr 2012 | Sankaran, Parameswaran |
| Real Analysis (Measure Theory) | Jul-Dec 2012 | Sunder, V. S. |
| A Course in Algebraic Number Theory | Aug-Dec 2012 | Balasubramanian, R. |
| Algebra I | Aug-Dec 2012 | Nagaraj, D. S. |
| Characteristic classes | Aug-Mar 2013 | Sankaran, Parameswaran |
| Complex Analysis | Aug-Dec 2012 | Krishna, M. |
| Discrete subgroups of Lie groups | Aug-Dec 2012 | Chatterjee, Pralay |
| Lie algebras and representation theory | Aug-Dec 2012 | Viswanath, Sankaran |
| Representations of Lie groups | Aug-Nov 2012 | Raghavan, K. N. |
| Topology I | Aug-Dec 2012 | Prasad, Amritanshu |
| Transcendental number theory | Sep-Nov 2012 | Gun, S. |
| Algebraic Topology | Jan-Apr 2013 | Nagaraj, D. S. |
| Functional Analysis | Jan-Apr 2013 | Chakraborty, Partha S. |
| Infinite dimensional Lie algebras | Jan-Apr 2013 | Viswanath, Sankaran |
| Problem Seminar in Commutative Algebra | Jan-May 2013 | Kodiyalam, Vijay |
| Representation Theory | Jan-Apr 2013 | Prasad, Amritanshu |

| | | |
|---|---|---|
| Representations of semisimple Lie groups | Jan-Feb 2013 | Sankaran, Parameswaran |
| Topics in Probability theory (elective course) | Jan-Apr 2013 | Sunder, V. S. |
| Transforms on Function spaces | Jan-Mar 2013 | Krishna, M. |
| A course in arithmetic | Mar-Apr 2013 | Gun, S. |

**Physics**

| | | |
|---|---|---|
| Gravitation and Cosmology | Jan-Apr 2012 | Sathiapalan, Balachandran |
| Nonlinear Dynamics | Jan-May 2013 | Sinha, Sitabhra |
| Quantum Information Theory (Reading Course) | Jan-May 2012 | Ghosh, Sibasish |
| Quantum Mechanics II | Jan-Apr 2012 | Mukhopadhyay, Partha |
| Short Course on Neutrinos | Jun-Jun 2012 | Rajasekaran, G. |
| Introduction to Elementary Particle | Aug-Dec 2012 | Murthy, M.V.N. |
| Mathematical Methods I | Aug-Dec 2012 | Sinha, Sitabhra |
| Mathematical Methods II | Aug-Dec 2012 | Rajesh, R. |
| Quantum Mechanics - I | Aug-Dec 2012 | Ghosh, Sibasish |
| Advanced Condensed Matter Physics | Jan-Apr 2013 | Ray, Purusattam |
| General Relativity and Cosmology | Jan-Apr 2013 | Date, G. |
| Introduction to AdS/CFT | Jan-Apr 2013 | Sathiapalan, Balachandran |
| Quantum Field Theory (QFT) - II | Jan-Apr 2013 | Shrihari, Gopalakrishna |
| Quantum Information Theory | Jan-May 2013 | Ghosh, Sibasish |

**Theoretical Computer Science**

| | | |
|---|---|---|
| Advanced Data Structures | Jan-May 2012 | Raman, Venkatesh |
| Analysis of Boolean functions (Reading course) | Jan-Apr 2012 | Mahajan, Meena B. |
| Computational Complexity I | Jan-Apr 2012 | Arvind, V. |
| Game theory | Jan-Apr 2012 | Ramanujam, R. |
| Logic | Jan-May 2012 | Lodaya, Kamal |
| Logic | Jan-Mar 2012 | Ramanujam, R. |
| Theory of Computation II | Jan-Apr 2012 | Lodaya, Kamal |
| Infinite discrete structures | Aug-Sep 2012 | Ramanujam, R. |
| Linear Programming and Combinatorial Optimization | Aug-Dec 2012 | Mahajan, Meena B. |
| Theory of computation | Aug-Dec 2012 | Lodaya, Kamal |
| Advanced automata theory | Jan-May 2013 | Lodaya, Kamal |
| Algorithms for special graph classes | Jan-Apr 2013 | Francis, Mathew C. |
| Mathematical Logic | Jan-Apr 2013 | Ramanujam, R. |
| Model theory and decidability | Jan-Apr 2013 | Ramanujam, R. |
| Logic | Apr-May 2013 | Lodaya, Kamal |
| Algorithms | Aug-Dec 2012 | Subramanian, C.R. |

In addition, the following **lecture courses** were offered during 2012 – 2013 by IMSC faculty in the National Undergraduate programme of the Chennai Mathematical Institute.

| Course Title | Period | Lecturer |
|---|---|---|
| **Mathematics** | | |
| Functional Analysis | Jan-Mar 2012 | Kesavan, S. |
| Real Analysis | Aug-Nov 2012 | Chakraborty, Partha S. |
| **Physics** | | |
| Particle Physics | Jan-Apr 2012 | Rajasekaran, G. |
| Classical Mechanics | Aug-Dec 2012 | Rajasekaran, G. |
| Statistical Physics-II | Aug-Nov 2012 | Mandayam, Prabha |
| Overview of Physics | Nov-Jan 2013 | Rajasekaran, G. |
| Quantum Mechanics | Jan-Apr 2013 | Rajasekaran, G. |

### 2.4.3 Summer Students

Every summer, a small number of students from various institutes/universities come to our institute and work on some learning/research projects with some faculty member for a period of four to six weeks. The following students visited the institute during Apr, 2012 - Mar, 2013.

| Student | Faculty |
|---|---|
| **Mathematics** | |
| Goswami, Ankush, NISER, Bhubaneswar | Balasubramanian, R. |
| Agarwal, Kesab, IISER, Mohali | Balasubramanian, R. |
| Singhal, Kritika, IISER, Mohali | Balasubramanian, R. |
| Saikia, Manjil P., Tezpur University | Balasubramanian, R. |
| Kumar, Guddu, IISER, Kolkata | Raghavan, K. N. |
| Satpathy, Punya P., IISER, Pune | Raghavan, K. N. |
| Pahi, Snata, IMA, Bhubaneswar | Raghavan, K. N. |
| Kumar, Gaurav, NISER, Bhubaneswar | Raghavan, K. N. |
| Gupta, Abhishek, IIT, Kanpur | Raghavan, K. N. |
| Dalai, Rupak K., IMA, Bhubaneswar | Raghavan, K. N. |
| Rajdeepak, Rishikant, NISER, Bhubaneswar | Raghavan, K. N. |
| Pramanik, Arghya, IMA, Bhubaneswar | Raghavan, K. N. |
| Amudhan, K. U., NISER, Bhubaneswar | Raghavan, K. N. |
| Dutta, Abhraneel , IMA, Bhubaneswar | Raghavan, K. N. |

**Physics**

| | |
|---|---|
| Pandey, Sweta, IISER, Bhopal (INSPIRE Fellow) | Date, G. |
| Roy, Kaushik , IISER, Bhopal (INSPIRE Fellow) | Date, G. |
| Nehra, Rajveer, IISER, Mohali | Mandayam, Prabha |
| Pathak, Aritro , IIT, Kanpur | Mukhopadhyay, Partha |
| Jaswin, Kasi, NISER, Bhubaneswar | Mukhopadhyay, Partha |
| Yuvaraj, S., IIT M, Chennai | Ray, Purusattam |
| Bag, Saientan, IIT,Kanpur | Ray, Purusattam |
| Kela, Aditya, CMI | Sathiapalan, Balachandran |
| Manchala, Prathyush, CMI | Sathiapalan, Balachandran |
| Vadakkayil, Nalina, NIT Calicut | Sinha, Nita |
| Potti, Harish, Indian School of Mines, Dhanbad | Sinha, Nita |
| Madaan, Pulkit, BHU | Sinha, Sitabhra |
| Hangal, Dhanush, IIT, Roorkee | Sinha, Sitabhra |
| Rajagopalan, Kabilan, Nehru Memorial College, Puthanampatti, Trichirappalli | Sinha, Sitabhra |
| Bora, Neha, IISER, Pune | Sinha, Sitabhra |
| Das, Pratyusha, Calcutta University | Sinha, Sitabhra |
| Pandey, Shubham, IISER, Pune | Sinha, Sitabhra |
| Paul, Kallol, IIT, Kharagpur | Sinha, Sitabhra |
| Dixit, Manu, BITS, Pilani | Sinha, Sitabhra |
| K, Ananthanarayana, SHASTRA University | Vemparala, Satyavani |

**Theoretical Computer Science**

| | |
|---|---|
| Hariram, K., IISER, Pune | Ramanujam, R. |
| Lakhani, Foram, BITS, Pilani | Ramanujam, R. |
| Agarwal, Shreya, NITK, Surathkal | Ramanujam, R. |

### 2.4.4 Other Students

Students also do their projects under the supervision of our faculty during the academic year. The following students visited the institute during Apr, 2012 - Mar, 2013.

| Student | Faculty |
|---|---|
| **Mathematics** | |
| Ashwin, T., IISER, Pune | Kesavan, S. |
| Sampath, Kannappan, ISI, Bangalore | Prasad, Amritanshu |
| **Physics** | |
| Kocherlakota, Prashant, IIT Madras | Sinha, Nita |

## 2.5 Honours and Awards

**Balasubramanian, R.** was awarded Life Time Achievement Award 2011, for 2013, by the Hon'ble Prime Minister of India.

**Chakraborty, Partha S.** was awarded Fellow, for 2012, by the National Academy of Sciences, India for his contributions in the fields of Noncommutative Geometry/ Operator Algebras/ Global Analysis.

**Francis, Mathew C.** was awarded INSPIRE Faculty Award, for 2013, by the Department of Science and Technology.

**Gun, S.** was awarded Associateship, for 2012, by the ICTP, Italy.

**Jaya Iyer** was elected Fellow of Indian Academy of Sciences, for 2013.

**Saket Saurabh** was awarded European Research Council grant of 1.69 Million Euros, by the European Research Council Executive Agency, Belgium, for his project on Parameterized Approximation.

# Chapter 3

# Other Professional Activities

This chapter lists the activities carried out by the individual members of the institute in their professional capacity.

**Balasubramanian, R.**

Chairman of Apex committee of National Centre for Mathematics(NCM), POWAI

Chairman of National Board for higher mathematics

Chairman of Governing Council of Chennai Mathematical Institute during Aug 2012 – Mar 2013.

Member of Governing council of Indian Statistical Institute, Kolkatta during Nov 2012 – Mar 2013.

Chairman of Research Council of SAG during Nov 2012 – Mar 2013.

Convener of Local Organising Committee for Legacy of Ramanujan held at University of Delhi during Dec 17 – Dec 22, 2012.

Gave a lecture at Workshop/seminar for media persons at Chennai Press club on Mar 19, 2013. Organised by vigyan prasar and NCSTC to initiate the media into coverage of issues related to mathematics

**Basu, Madhushree**

Gave lecture at Mathematics Workshop for senior school students at Institute of Mathematical Sciences, Chennai on Oct 31, 2012.

**Bhattacharya, Soumyadeep**

Volunteer at The Institute of Mathematical Sciences, Chennai on Mar 10, 2013. Demonstrations

**Chakraborty, Partha S.**

Invited speaker at IISC, Bangalore on Jun 21, 2012. History aspects and prospects of mathematics in India, a two day program for undergraduate and postgraduate mathematics students

Speaker at IMSC on Jun 19, 2012. History aspects and prospects of mathematics in India, a two day program for undergraduate and postgraduate mathematics students

**Gun, S.**

Reviewer of Mathematical Reviews during Jul 2008 – Mar 2013.

Reviewer of Zentralblatt Reviews during Apr 2011 – Mar 2013.

Convener of the month long Summer Program at IMSc on Jun 25, 2012. Around 50 people attended this program. Basics of algebra, analysis and topology were taught by mathematicians from CMI and IMSc.

Convener of Local Organising Committee for Panorama Lectures by Kumar Murty held at IMSc during Aug 4 – Aug 9, 2012.

Convener of Local Organising Committee for Panorama Lectures by Joseph Oesterle held at IMSc during Oct 2 – Oct 15, 2012.

**Kesavan, S.**

Reviewer of Mathematical Reviews

Fellow of Forum d' Analystes

Member of NBHM Liaison Committee for the Kerala School of Mathematics

Member of UGC Review Committee (Mathematics), IISc, Bangalore

Member of National Board for Higher Mathematics

Member of Academic Council, Chennai Mathematical Institute

Secretary (Grants) of Commission for Developing Countries (CDC) of the International Mathematical Union (IMU)

Member, Steering Board, Indo-French Centre for Applied Mathematics (IFCAM)

Member selection Committee, **Abel Visiting Scholarship Programme** of the Abel Foundation and IMU, 2013-2016

Member of Anna University Committee for equivalence of general and business mathematics for B.Arch programme during Feb – Feb, 2013.

Member of Faculty selection Committee, NISER, Bhubaneswar during Feb – Feb, 2013.

**Kodiyalam, Vijay**

Convener of Local Organising Committee for Workshop on Subfactors and Planar Algebras held at IMSc during Mar 26 – Apr 3, 2012.

Convener of Local Organising Committee for SunderFest held at IMSc during Apr 4 – Apr 6, 2012.

**Lodaya, Kamal**

Convener of National Organising Committee for 11th Formal methods update meeting held at CMI during Jul 19 – Jul 21, 2012.

Member of International Organising Committee for 5th Indian conference on logic and applications held at IMSc during Jan 10 – Jan 12, 2013.

Member of International Organising Committee for 14th conference on Theoretical aspects of rationality and knowledge held at IMSc during Jan 7 – Jan 9, 2013.

**Murthy, M.V.N.**

University Nominee of Board of Studies, Vivekananda College, University of Madras

Convener of National Organising Committee for Pathways to Higgs Boson (Organised by Academies) held at American College, Madurai during Aug 28 – Aug 29, 2012.

Member of International Organising Committee for 8th International Workshop on Neutrino-Nucleus Interaction in few-Gev Region (NuInt 12) held at Centro Brasileiro de Pesquisas Fsicas (CBPF) Rio de Janeiro - Brazil during Oct 22 – Oct 27, 2012.

Convener of National Organising Committee for Lectures on Theoretical Physics (organised by the Academies) held at Department of Physics, University of Mysore during Nov 8 – Nov 10, 2012.

DST Inspire program at VVS First grade College, Bangalore on Dec 26, 2012. Invited lecture on "Standard Model and Higgs boson: An elementary introduction "

**Nagaraj, D. S.**

Convener of Local Organising Committee for Work shop on Algebra held at University of Mysore during Jul 31 – Aug 2, 2012.

**Prasad, Amritanshu**

Organised a thematic summer program on finite fields at IMSc Chennai on May 14, 2012. A three week program for BSc and MSc students introducing them to modern number theory via the topic of finite fields.

The program was attended by more than thirty students and consisted of lectures by research mathematicians and project work.

Member of ISTE Srinivasa Ramanujan Mathematical Competitions Project expert committee during Aug 2012 – Mar 2013.

DST INSPIRE camp talk on the necklace problem at Anna Univesity, Chennai on Oct 12, 2012.

**Raghavan, K. N.**

DST Inspire Internship Camp at BSNL Training Centre, Maraimalai nagar, Chennai (Conducted by Presidency College, Chennai) on May 25, 2012. Lectured to and interacted with school students.

DST Inspire Internship Camp at DMI College of Engineering, Palanchur, Chennai on May 2, 2012. Participated as “mentor”. Lectured to and interacted with a batch of 150 interns for an entire morning session.

Convener of National Organising Committee for History, Aspects, and Prospects for Mathematics in India held at IMSc during Jun 18 – Jun 19, 2012.

Convener of Local Organising Committee for Course for summer interns in Representation Theory held at IMSc during Jun 4 – Jun 15, 2012.

Member of Advisory Committee for IMSc Outreach three day Workshop on Algebra and its Applications held at University of Mysore during Jul 30 – Aug 1, 2012.

DST Inspire Internship Camp at Vel Tech, Avadi, Chennai on Aug 11, 2012. Lectured to and interacted with school students.

DST Inspire Internship Camp at BSNL Training Centre, Maraimalai nagar, Chennai (Conducted by Presidency College, Chennai) on Sep 29, 2012. Lectured to and interacted with school students.

DST Inspire Internship Camp at DMI College of Engineering, Palanchur, Chennai on Oct 29, 2012. Lectured to and interacted with school students.

Guest lecture on mathematics for school students at Bala Vidya Mandir School, Adyar, Chennai on Dec 6, 2012. Gave a lecture on elementary number theory (solving congruences, Chinese remainder theorem).

Guest lecture on mathematics for school students at P. S. Senior Secondary School, Mylapore, Chennai on Dec 3, 2012. Gave a lecture on elementary number theory (solving congruences, Chinese remainder theorem).

Convener of National Organising Committee for IMSc Outreach three day workshop: Introduction to Field Theory via Geometry and Number Theory held at University of Mysore during Feb 4 – Feb 6, 2013.

**Rajasekaran, G.**

Member of Academic Council of CMI

Chairman of Board of Studies in Physics,CMI

Member of Scientific Steering Committee of INO

Popular Science article published at Chennai on Jul 27, 2012. Wrote the article "The Long Journey" in the News Magazine "Front Line", dated 27 July 2012.

Popular Science article at Madurai on Jul 31, 2012. Wrote a popular science article in Tamil on "Hundred years of fundamental physics and the Higgs boson" published in "Mulumai Ariviyal Udayam". July 2012.

Colloquium Talk at IMSc on Aug 13, 2012. Gave a Colloquium talk on "Standard Model, Higgs Boson and What Next?"

Colloquium at CMI on Aug 16, 2012. Gave a Colloquium talk on "Standard Model, Higgs Boson and What Next?"

Popular lectures in Science at Danalakshmi College of Engineering, Tambaram on Dec 19, 2012. Gave two lectures:1. Standard Model of Particle Physics, 2. Neutrinos and INO.

Organization of a meeting at Madras Christian College, Tambaram on Dec 11, 2012. A meeting was organized at MCC, Tambaram, on the occasion of the visit of Professor TWB Kibble to Chennai, to expose to the students and others the outstanding contributions of Kibble in the development of the Standard Model of HEP.

Popular Science talk at CMI on Jan 12, 2013. Gave an elementary talk on "Neutrinos and INO" to School students in a program sponsored by the National Academy of Sciences, Allahabad.

**Raman, Venkatesh**

Convener of Local Organising Committee for Golden Jubilee Thematic Lectures in Computer Science held at IMSc during Apr 21 – Aug 25, 2012.

Convener of Local Organising Committee for ISI-IMSc summer school on Network optimization and security held at IMSc during May 21 – May 31, 2012.

Convener of National Organising Committee for Advanced School on Graph Algorithms held at Birla Institute of Technology and Science Pilani, Goa Campus during Jul 23 – Jul 27, 2012.

Member of Program Committee of Seventh International Workshop on Algorithms and Computation (WALCOM 2013) during Sep 2012 – Feb 2013.

**Ramanujam, R.**

Member of Editorial Board of Journal of Philosophical Logic during Apr 2011 – Mar 2013.

Program committee member of Third International Symposium on Games, Automata, Logics and Formal Verification during May 2011 – May 2012.

Program committee member of Workshop on Logical Aspects of Multi-Agent Systems during Jun 2011 – Jun 2012.

Program Committee member of 13th International Workshop on Computational Logic in Multi-Agent Systems during Oct 2011 – Aug 2012.

Program Committee member of International Conference on Distributed Computing and Networking during Apr 2012 – Jan 2013.

Program Committee member of 1st International Workshop on Strategic Reasoning during May 2012 – Mar 2013.

Convener of Local Organising Committee for Theoretical Aspects of Rationality and Knowledge held at IMSc during Jan 7 – Jan 9, 2013.

Convener of Local Organising Committee for Indian Conference on Logic and Applications held at IMSc during Jan 10 – Jan 12, 2013.

Member of Local Organising Committee for Annual conference of the Association of Computing Machinery (ACM-India) held at IIT, Madras during Jan 22 – Jan 24, 2013.

**Ray, Purusattam**

Convener of International Organising Committee for Defects and Heterogeneities in Fracture and Flow held at IMSc during Jan 21 – Jan 24, 2013.

Convener of National Organising Committee for Diversity and Complexity: Realm of Today's Statistical Physics held at Saha Institute of Nuclear Physics, Kolkata during Jan 14 – Jan 17, 2013.

**Sankaran, Parameswaran**

Convener of Local Organising Committee for ATM Workshop in Topology held at IMSc during Feb 4 – Feb 9, 2013.

**Sinha, Nita**

Coordinator of Working groups C:Heavy quarks and CP Violation and D:Neutrino Physics, Non-Accelerator Physics, Particle Astrophysics and Cosmology of the XX DAE-BRNS HEP Symposium, during Jan 2012 – Jan 2013.

Member of Local Organising Committee for Frontiers of High Energy Physics IMSc Golden Jubilee Symposium held at IMSc during Dec 10 – Dec 13, 2012.

Member of National Organising Committee for XX DAE-BRNS HEP symposium held at Visva-Bharati, Santiniketan during Jan 13 – Jan 18, 2013.

**Sinha, Sitabhra**

Member of Editorial Board of Frontiers in Fractal Physiology

Adjunct Faculty of National Institute of Advanced Studies

Convener of Local Organising Committee for INCF Workshop on Neuroinformatics of sensory-motor integration: modeling and imaging from the worm to the human nervous system held at IMSc during Nov 5 – Nov 7, 2012.

**Srinivas, K.**

Member of Kendriya Vidyalaya Management Committee during Jan 2011 – Dec 2012.

Invited Speaker at KIIT University, Bhubaneswar on Apr 27, 2012. Delivered two talks on *how to enjoy doing mathematics* in the DST sponsored INSPIRE programme to +2 level students.

Treasurer of Executive Committee of Ramanujan Mathematical Society

Member of Kendriya Vidyalaya Management Committee, KV CLRI

Member of Faculty Recruitment Board, Central University of Jharkhand, Jharkhand during Jul – Jul, 2012.

Resource person at VelTech University, Chennai on Aug 12, 2012. Delivered two talks on *Applications of Mathematics* in the DST sponsored INSPIRE programme for +2 students.

Resource person at VIT, Chennai on Aug 4, 2012. Delivered a talk on *Srinivasa Ramanujan-some glimpses of his mathematics* in the science popularization programme organized by Tamilnadu Science Forum.

Convener of Local Organising Committee for Workshop for School Teachers held at IMSc during Aug 10 – Aug 11, 2012.

Convener of Local Organising Committee for Hindi Kavi Sammelan held at IMSc on Sep 14, 2012.

Convener of Local Organising Committee for Workshop for school students held at IMSc on Oct 31, 2012.

Chief Guest at KV CLRI, Adyar on Oct 6, 2012. Inaugurated the Mathematics club of KV, CLRI, Adyar, Chennai, gave a speech on the Career Opportunities in Mathematics to high school students.

Convener of Local Organising Committee for Workshop for college teachers held at IMSc during Nov 29 – Nov 30, 2012.

Speaker at Wada, Mumbai on Dec 29, 2012. Addressed a gathering of about 400 school and college going students of Wada area near Mumbai. The aim was to encourage and motivate the young students to study and enjoy mathematics. This event was organized by Mr. Santosh Gaikwad, a resident of Wada.

Resource person at KV CLRI, Adyar on Dec 28, 2012. Delivered a talk in Number theory in the PGT teaching program, organized by KV, CLRI, Chennai.

**Viswanath, Sankaran**

Lecturer in the summer maths workshop for M.Sc students

at IMSc on Jun 25, 2012.

Lecturer in the workshop for summer students at IMSc/IISc on Jun 19, 2012. Workshop on the “History, aspects and prospects of mathematics”.

Lecturer in the workshop for school teachers at IMSc on Aug 10, 2012. Part of the IMSc Golden Jubilee year.

Lecturer in the UGC refresher course on topology at Ramanujan Institute. on Oct 5, 2012.

Lecturer in the workshop for college teachers at IMSc on Nov 29, 2012. Part of the IMSc

Golden Jubilee year.

# Chapter 4

# Colloquia

## 4.1 Conferences/Workshops Held at IMSc

### 4.1.1 SunderFest

This was a 3 day workshop on the occasion of V. S. Sunder's 60th birthday in honour of his accomplishments as a mathematician, teacher, mentor and colleague. This was well attended by several mathematicians both from within India and outside. There were around 5 talks daily with one of the afternoons dedicated to a felicitation program for Sunder.

### 4.1.2 IMSc GOLDEN JUBILEE Celebrations: Highlights

The Institute of Mathematical Sciences (IMSc) was founded by Alladi Ramakrishnan in 1962. Originating from a small but vibrant Theoretical Physics Seminar of Madras University, it was a small research institute which was taken over by the Department of Atomic Energy in 1984, since when it has grown considerably, now ranking as a premier institution in India for research in Mathematics, Theoretical Physics and Theoretical Computer Science. However, as international review by the SRS Varadhan Committee indicated, the institute could well double its size in the next decade, well-placed as it is for interdisciplinary research. A proposal to achieve this is under consideration by the Government. Meanwhile the institute has plans for expansion of infrastructure; the foundation stone for library extension was laid by the Thiru Palaniappan, Hon. minister for Higher Education, Govt. of Tamil Nadu on January 3.

Celebrating its golden jubilee, IMSc organized a series of events during 2012, including 12 national and international meetings on research themes and 7 national instructional workshops and schools for research students. In addition, IMSc held a monthly lecture series, each consisting of a day-long set of lectures on a theme in Theoretical Computer Science. Workshops were held even for high school students, for high school teachers and for college teachers. A separate workshop addressed (in Tamil) mathematics teachers from schools of Chennai Corporation.

These events culminated in a golden jubilee conference at IMSc from January 2 to 4. A photographic exhibition presenting the institute's history was inaugurated by Dr. M R Srinivasan, former Chairman of the Atomic Energy Commission. A booklet and a short film on the theme were also released. Prof. Krishnaswami Alladi (Univ of Florida, USA) talked of the genesis and early years of the institute.

On January 3 and 4, a number of presentations by eminent international experts offered IMSc members and alumni a panormic view of research trends in many areas. Public talks took these discussions to students and teachers from all over Chennai. Prof. Ashoke Sen (Harishchandra Research Inst, Allahabad) showed how holography could be used to define quantum gravity, and how recent work was approaching computations on black hole horizons. In his public talk, Prof. T V Ramakrishnan (IISc, Bangalore and BHU-IT, Varanasi) presented the challenge of understanding families of systems in which a large number of electrons could be mobile while being subjected to strong constraints that make them avoid each other. He suggested that the pressing demands from oxide interfaces and oxide electronics may lead to new science and powerful new technology.

The mathematician Prof. Benedict Gross (Harvard University, USA) raised a very simple question: how does one decide whether a cubic equation has finitely many or infinitely many rational solutions ? In a spectacular lecture, he took the audience through a tour of centuries, from the work of Fermat in the 16th century to his current research in collaboration with Prof. Manjul Bhargava (Princeton University, USA) that is yielding probabilistic answers to such questions, and in the process leading to very rich mathematics. Prof. Ramanan (Chennai Math Institute), starting with representations of elliptic curves by complex numbers, went on to explain the concept of moduli spaces of vector bundles. This is an area in which in post-independence India, mathematicians from here have made major contributions.

In another public talk, Prof. Umesh Vazirani (Berkeley University, USA) spoke of how MOOCs (massive open online courses) may well change the shape of higher education by breaking access barriers, using the example of his own course on quantum computation which was successfully completed by more than 2000 students from all over the world.

On Friday, Prof Leonid Pastur of the Institute of Low Temperature Physics, Ukraine, discussed the powerful laws of large numbers. He discussed a universality principle generalizing the central limit theorem, which holds for some class of random matrices, but generalizing which is a major challenge of modern mathematics.

Prof. George Sterman, a Theoretical Physicist from State University of Stony Brook, USA, undertook a journey through the construction and experimental verification of the standard model, explaining the complexities to be resolved yet, especially in quantum chromodynamics. Prof. Joseph Halpern of Cornell University, USA, showed fundamental connections between algorithms for distributed systems (such as the communication protocols underlying Internet) and the mathematics of game theory. He suggested that both could learn from each other, to build more realistic and more sophisticated models.

The golden jubilee conference concluded with two public talks by Prof. Rafael Sorken of Perimeter Institute, Canada and by Prof. J Oesterle of University of Paris.

Prof. Sorken talked about the searches for a theory of Quantum Gravity, an important open problem in frontiers of Physics since Einstein formulated the general theory of relativity and the advent of quantum field theories. He presented the Causal Set hypothesis in which the space-time evolution is based on on underlying organically constructed discreteness. The kinematics, dynamics and the phenomenological implications of this idea towards a theory of Quantum Gravity were presented by Prof. Sorken.

In a very entertaining lecture, Prof. Oesterle presented some extremely simple looking but unsolved problems in Mathematics. From the problem of showing the existence of periodic orbits in a triangular enclosure, the problem of predicting the n'th member of a self generating sequence of 1 and 2's all the way up some problems in primes were presented in a simple language which every one could understand were discussed by Prof. Oesterle.

Even as the golden jubilee celebration of IMSc ended, a last event associated with the golden jubilee got under way in Pondicherry. Titled, Bayes by the Bay, it is a pedagogical workshop that aims to familiarise students and scientists with the use and application of Bayesian statistics in various areas of science.

**Frontiers of High Energy Physics IMSc Golden Jubilee Symposium**

The Frontiers of High Energy Physics (FHEP) Symposium was held at IMSc from December 10th to 13th 2012. About 50 graduate students from across India benefited from the set of pedagogical lectures delivered by very eminent speakers from around the world. The following speakers gave lectures at the FHEP Symposium.

- **Tom Kibble**, Imperial College, UK

  *Genesis of the Higgs mechanism and electroweak symmetry breaking*

- **Romesh Kaul**, IMSC

  *Electro-Weak Symmetry Breaking and Naturalness: A window to Physics beyond Standard Model*

- **Kajari Mazumdar**, TIFR, Mumbai

  *Status of Higgs search at the LHC*

- **Marina Artuso**, Syracuse University, USA

  *Flavor physics challenge to the Standard Model*

- **Rohini Godbole,** IISc, Bangalore

  *We have found a boson; what next?*

- **Tom Kibble,** Imperial college, UK

  *What is the Higgs? - What is it for?*

- **Boris Kayser,** Fermilab, USA

  1. *Tensions with the Three-Neutrino Paradigm;*
  2. *Leptogenesis as the Origin of the Cosmic Matter-Antimatter Asymmetry*

- **Andre De Gouvea,** Northwestern University, USA

  1. *Neutrinos have Mass - So What?;*
  2. *Muon Physics, relation to neutrinos and other physics beyond the standard model*

- **Naba Mondal,** TIFR, Mumbai

  *India-based Neutrino Observatory Project*

- **Alessandro Bettini**, INFN, Italy and LSC, Spain

  *The Search for neutrino-less double-beta decay*

- **Rupak Mahapatra**, Texas AM University, USA

  *Worldwide Searches for Dark Matter*

- **Harald Fritzsch**, Ludwig-Maximillians-Universitat, Germany

  1. *Quantum Chromodynamics;*
  2. *Composite Weak Bosons;*
  3. *Escape from Leipzig*

- **Hai-Yang Cheng**, Institute of Physics, Academia Sinica, Taiwan

  1. *Scalar and pseudoscalar glueball;*
  2. *Direct CP violation in D decays*

- **Abhay Deshpande**, Stony Brook University/RBRC, USA

  *Understanding the Nucleon Spin: Present experimental opportunities and future challenges*

- **Bikash Sinha**, SINP/VECC, Kolkatta

  *The mini Bang to Big Bang - From Collider to Cosmology, SPS - RHIC - LHC*

- **Biswarup Mukhopadhyaya**, HRI Allahabad

  *The Higgs Boson and Beyond*

- **Sheldon Stone**, Syracuse University, USA

  *Indirect manifestations of New Physics: experimental tests*

- **Raman Sundrum**, University of Maryland, USA

  *Warped Compactification, AdS/CFT, and the LHC*

**Golden Jubilee Thematic Lectures in Computer Science**

In celebration of IMSc's 50th year, during March to December 2012, the theoretical computer science group arranged thematic lectures aimed at college teachers and students, one Saturday every month. The ten programmes are listed below.

The first of these was on March 17th, 2012, on the theme *Aha! Divide and Conquer*. The speakers were C. Pandu Rangan (IIT Madras), Vikram Sharma and Venkatesh Raman.

The second of these was on April 21st, 2012, on the theme *Randomization in Computer Science*. The speakers were Partha Mukhopadhyay (CMI), Sourav Chakraborty (CMI), C.R. Subramanian and V. Arvind.

The third of these was on May 19th, 2012, on the theme *Graphs: Explorations and Algorithms*. The speakers were Venkatesh Raman, N.S. Narayanaswamy (IIT Madras), V. Arvind and Saket Saurabh.

The fourth of these was on June 23rd, 2012, on the theme *Concurrency in the Multicore Age*. The speakers were Kamal Lodaya, R. Ramanujam, S.P. Suresh (CMI) and S. Sheerazuddin.

The fifth of these was on July 21st, 2012, on the theme *Automata in the Real World*. The speakers were K. Narayan Kumar (CMI), Madhavan Mukund (CMI), Supratik Chakraborty (IIT Bombay) and R. Ramanujam.

The sixth of these was on August 25th, 2012, on the theme *A Celebration of Turing*. The speakers were R. Ramanujam, Kamal Lodaya, Sitabhra Sinha and S.P. Suresh (CMI).

The seventh of these was on September 15th, 2012, on the theme *Matchings in graphs*. The speakers were Meena Mahajan, Vikram Sharma and Prajakta Nimbhorkar (CMI).

The eighth of these was on October 20th, 2012, on the theme *Computational geometry: Searching for a nearest neighbor*. The speakers were Sasanka Roy (CMI), John Augustine (IIT Madras) and Vikram Sharma.

The ninth of these was on November 24th, 2012, on the theme *Matroids and algorithms*. The speakers were Saket Saurabh, Manu Basavaraju, Fahad Panolan and Pranabendu Misra.

The tenth of these was on December 22nd, 2012, on the theme *Network flows*. The speakers were V. Arvind, V. Sunitha (DAIICT, Gandhinagar), N.S. Narayanaswamy (IIT Madras) and C.R. Subramanian.

### 4.1.3 History, Aspects, and Prospects for Mathematics in India

The two day program featured a lecture on history of Mathematics in India by Professor S. G. Dani (TIFR), a panel discussion on prospects for careers in Mathematics in India with Professors R. Karandikar (CMI) and S. Kesavan (IMSc) as panelists, and lectures on various aspects of mathematics by eight experts. There were about 130 participants, mostly upper undergraduate and postgraduate students of mathematics, but also others. The program was part of the National Mathematics Year celebrations and was sponsored by the three scientific academies. The entire proceedings, except for one lecture, has been recorded by NPTEL.

### 4.1.4 Course for summer interns in Representation Theory

The two week course consisted of ten intensive lectures (given by Amritanshu Prasad, K. N. Raghavan, and S. Viswanath) aimed at summer students at IMSc (although the participation was not limited to these students). The summer students had also to follow this up later by working on a project for about two weeks.

### 4.1.5 Workshop for School Teachers

**Workshop for School Teachers:** A two-day lecture programme was held on Aug 10-11, 2012 (Friday-Saturday) at IMSc. About 60 higher secondary (HS) school teachers from Chennai schools participated in this program. IMSc faculty delivered lectures on differential equations, calculus, probability and combinatorics, linear algebra, coordinate geometry and number theory. There was a one hour session devoted to panel discussion on High School Mathematics: *Motivating the mathematically inclined.*

**Feedback from the school teachers:** Almost all of them said the program was quite useful, refreshed ideas, recalled deep concepts in easier way, threw light on basic concepts, learned lot of extra things which will help them in developing skills to teach well, they were able to correlate the elementary with higher mathematics, learned things which are not part of school syllabus, important doubts were cleared, bridged the gap between school and higher mathematics, came to know about IMSc.

They suggested that it is a good idea to devote about 25-30 per cent of the time for discussion hour, it will be useful for clarifying their doubts. All of them strongly asserted that such programs should be conducted regularly. Some teachers felt that the topic and content of the lecture should be matched with school syllabus, short cut methods should be discussed, teaching methodology should be discussed.

All of them expressed deep appreciation for the entire event.

### 4.1.6 Panorama Lectures by Kumar Murty

In these lectures, the concept of bounded generation of groups, particularly in the context of arithmetic groups were introduced. The deep connection of this concept with representation theory, geometry and number theory were established. The lecturer also presented estimates for the degree of bounded generation for some classical groups.

### 4.1.7 Hindi Kavi Sammelan

On the eve of Hindi Diwas celebrations, IMSc organized a Kavi Sammelan on September 14, 2012. Five professional writers/poets in Hindi graced this occasion. Prof. Arvind Rai and Prof. Brajbhushan Tiwari from Bhagalpur University, Bihar, Sri Mahendra Kumar from KV CLRI, Sri Pandey from KV Annanagar, Smt Vibha Rani from Indian Oil recited poems in Hindi. Mr. Prem Prakash Pandey, SRF from IMSc presented a short discourse in Hindi on *how to live happily even after marriage!*, Mr. Shiraj recited some beautiful urdu poems. The programme was anchored by K. Srinivas.

### 4.1.8 Workshop for School Students

There was a one day lecture program on October 31 (wednesday), 2012 for higher secondary students (XI & XII std) from various schools in Chennai. Despite, rough weather on that particular day, there were about 40 participants who attended this program. Lectures on basic mathematics were delivered by IMSc students, post doctoral fellows and faculty.

### 4.1.9 Panorama Lectures by Joseph Oesterle

In these series of lectures, a comprehensive account of the state of the art of the theory of multiple zeta values was delivered with special emphasis on the remarkable recent works of D. Zagier and F. Brown.

### 4.1.10 Workshop for College Teachers

For UG/PG lecturers from in and around Chennai, a 2 day workshop was organized on Nov 29-30 (thursday-friday), 2012. About 35 teachers participated in this program. Lectures by IMSc faculty covered fundamentals of differential equations, algebra, topology, real analysis, complex analysis and linear algebra.

**Feedback from college teachers:** The program helped them to learn basic concepts, understand the in-depth concepts of the subject to teach well in the class, learned the art of teaching, learned how to think logically and relate it to other areas of mathematics, reviewed, recollected concepts, understood some applications of mathematics.

The college teachers felt that we should allot sometime for discussion hour and all of them were unanimous in saying that such programs should be conducted frequently, particularly during semester holidays in Dec-May, Sept-June.

All of them thanked the resource people and IMSc for organizing the event.

### 4.1.11 INCF Workshop on Neuroinformatics of sensory-motor integration: modeling and imaging from the worm to the human nervous system

The workshop explored neuroinformatics approaches to questions of how sensory signals from the environment are integrated at different scales - from the level of a single neuron to the entire brain - eventually resulting in motor responses. It will address issues of collecting, integrating and modeling diverse types of neuroscience data - an important strategic step towards increased understanding of the brain in health and disease.

The event was jointly organized by the Institute of Mathematical Sciences, Indian Institute of Technology-Madras (IIT-M) and the Indian National Node of Neuroinformatics (INNNI) which is the Indian National Node of the International Neuroinformatics Coordinating Facility (INCF). The following gave lectures at the workshop:

- **Sten Grillner**, Nobel Institute for Neurophysiology, Karolinska Institute, Stockholm, Sweden

  *The logics of networks in motion - large scale modeling from ion channels to behavior*

- **Dieter Jaeger**, Emory University, Atlanta

  *Synaptic Integration in Globus Pallidus Neurons*

- **Bapi Raju**, Centre for Neural and Cognitive Sciences, University of Hyderabad

  *On the role of attention in implicit sequence learning*

- **Krishanu Ray**, Tata Institute of Fundamental Research, Mumbai

  *Role of Kinesins in slow and fast axonal transport*

- **Aditya Murthy**, Centre for Neuroscience, Indian Institute of Science, Bangalore

  *Brain mechanisms controlling decision-making and motor planning*

- **Jeanette Kotaleski**, School of Computer Science and Communication, KTH Royal Institute of Technology, Stockholm, Sweden

  *Multi-scale modeling exemplified in the basal ganglia, and a brief update on the Swedish INCF node activities*

- **Arvind Kumar**, University of Freiburg, Freiburg

  *Dynamic state dependent modulation of correlations in spiking neural network*

- **Sanjay Sane**, National Center for Biological Sciences, Bangalore

  *Sensory-motor integration in the insect antennal positioning response*

- **Catharine Rankin**, University of British Columbia, Vancouver, Canada

  *High-throughput phenotypic profiling of behavioral plasticity in 508 C. elegans nervous system mutants*

- **Mei Zhen**, Samuel Lunenfeld Research Institute, Toronto

  *An Optogenetic and Genetic Interrogation of Patterned Movements*

- **Sandhya Koushika**, Tata Institute of Fundamental Research

  *Regulation of synaptic vesicle transport*

- **Rishikesh Narayanan**, Indian Institute of Science, Bangalore

  *Functional maps within a single neuron*

- **Madhusudhan Venkadesan**, National Center for Biological Sciences, Bangalore

  *Neuromechanics of finger contacts: How to hold an object*

- **Andres Villu Maricq**, University of Utah, Salt Lake City

  *The workings of a synapse: parts, delivery and plasticity*

- **Nivedita Chatterjee**, Vision Research Foundation, Chennai

  *Does developmental constraints decide the structure of the C.elegans nervous system?*

- **Kaushik Majumdar**, Indian Statistical Institute, Bangalore

  *Video synchronization in schizophrenia*

- **Joby Joesph**, Center for Neural and Cognitive Sciences, University of Hyderabad, Hyderabad

  *Glimpses of a model organism for addressing sensory motor integration: Grasshopper*

- **G Rangarajan**, Indian Institute of Science, Bangalore

  *Granger Causality and fMRI Data*

- **Vatsala Thirumalai**, National Center for Biological Sciences, Bangalore

  *Descending motor control during development*

- **Pranay Goel**, Indian Institute of Science Education and Research, Pune

  *Glucose stimulates insulin secretion in pancreatic islets via multiple dynamic modes*

- **Narayanan Srinivasan**, Center for Behavior and Cognitive Science, University of Allahabad, Allahabad

  *Perception-action interactions, hierarchical control, and self*

- **Raghavendra Singh**, IBM India Research Lab, New Delhi

  *Network-theoretical mining and analysis of long distance pathways in the macaque brain*

- **Prasun Roy**, National Brain Research Center, Manesar

  *A neuroinformatics approach for treatment planning in sensori-motor stroke. Neuroimaging talks to Systems Biology: Making the Twain Meet*

### 4.1.12 5th Indian conference on logic and applications

ICLA is a biennial international conference on logic and applications. ICLA is a forum for bringing together researchers from a wide variety of fields that formal logic plays a significant role in, along with mathematicians, philosophers and logicians studying foundations of formal logic in itself.

The 5th ICLA was organized by IMSc. The Programme Committee was chaired by Prof. Kamal Lodaya, who is also a member of the Organizing Committee. The ICLA 2013 conference proceedings is published as LNCS 7750 in the Springer Lecture Notes in Computer Science series [**L**].

The conference had invited talks by Max Cresswell, Victoria University of Wellington, Mirna Dzamonja, University of East Anglia, Joseph Halpern, Cornell University, Martin Otto, Technische Universitaet Darmstadt, Mark Reynolds, University of Western Australia, Adriane Rini, Massey University and Gabriel Sandu, University of Helsinki. In addition, there were 15 contributed talks and 6 short presentations. The conference was attended by nearly 100 researchers.

### 4.1.13 14th conference on Theoretical aspects of rationality and knowledge

TARK 2013 is the 14th conference of the international TARK conference series. Previous conferences have been held bi-annually around the world. The 13th conference was held 2011 at the University of Groningen, Netherlands, and the 15th will be held in July 2015 at Carnegie Mellon University, USA. It brings together researchers from a wide variety of fields, including Artificial Intelligence, Cryptography, Distributed Computing, Economics and Game Theory, linguistics, philosophy and psychology in order to further our understanding of interdisciplinary issues involving reasoning about rationality and knowledge. It had invited talks by Fangzhen Lin (Hong Kong University of Science and Technology) and Rineke Verbrugge (University of Groningen, the Netherlands), and 18 contributed papers. The conference was attended by 86 researchers, more than half of them from outside India.

### 4.1.14 Defects and Heterogeneities in Fracture and Flow

Defects and heterogeneities are central to fracture and flow processes. Right from nucleation to propagation of fracture, ductility and brittleness, fracture surface morphologies, statistics and size dependence of strengths, avalanches in fracture and flow - various features are outcome of the nature, topology and mobility of the defects. The objective of the meeting was to bring in a concerted view of the present day understanding of the role of defects and heterogeneities in fracture and flow. There were 17 speakers out of which 10 were from abroad.

### 4.1.15 ATM Workshop in Topology

About twenty research scholars and PDFs participated. Lectures on the following topics were given: (1) Spectral sequences and homotopy groups of spheres, by Prof. A R Shastri, IIT Bombay. (2) Steenrod algebra and its dual, by Prof. Goutam Mukherjee, ISI Kolkata. (3) Formal group law and the complex cobordism ring, by Prof Samik Basu, Vivekananda University, Belur.

## 4.2 Other Conferences/Workshops Organized by IMSc

### 4.2.1 11th Formal methods update meeting

The annual Formal methods update meeting brings together researchers (and especially students) in the broad areas of automata theory, programming languages, logic and verification to present to each other recent work in the area. The 11th update meeting was organized at Chennai Mathematical Institute. This year's meeting drew 33 participants from all over India and one from outside India. Prof. Kamal Lodoya, IMSc, gave a talk on "Probabilistic systems and their verification".

### 4.2.2 Advanced School on Graph Algorithms

This was a school with the intended audience of college teachers.

Organized the academic program and gave several lectures on graph algorithms.

### 4.2.3 IMSc Outreach three day Workshop on Algebra and its Applications

The workshop was part of the outreach efforts by IMSc during its Golden Jubilee year. It was organized by D. S. Nagaraj (IMSc) and D. D. Somashekhara (University of Mysore). The resource persons were D. S. Nagaraj and K. N. Raghavan. On each of the three days, there were two lectures in the morning sessions, one by each resource person, and two problem sessions in the afternoons, again one by each resource person. The program was attended by about seventy second year M. Sc. students of the University. Research scholars and faculty of the University also took part in the activities. A conscious effort was made to educate students about research prospects in mathematics.

### 4.2.4 8th International Workshop on Neutrino-Nucleus Interaction in few-Gev Region (NuInt 12).

Prof.M.V.N. Murthy was a member of the Scientific Program Committee of NuInt12 held in Rio de Janeiro.

### 4.2.5 Legacy of Ramanujan

Prof. R. Balasubramanian was a member of the National committee , organising committee and scientific committee. Gave a plenary lecture on "zeros of quasi modular forms "

### 4.2.6 Diversity and Complexity: Realm of Today's Statistical Physics

An International Workshop Conference on the Diverse Applications of Statistical Physics. The broad topics included were: 1. Disorder, Fluctuations and Complexity, 2. Fracture, Breakdown and Earthquakes, 3. Quantum Phenomena: Criticality and Dynamics, 4. Social and Economic problems. There were 13 speakers from abroad and 14 speakers from different Universities and Institutes in India.

### 4.2.7 XX DAE-BRNS HEP Symposium

Prof. Nita Sinha was a Coordinator for groups C:Heavy quarks and CP Violation and D:Neutrino Physics, Non-Accelerator Physics, Particle Astrophysics and Cosmology

### 4.2.8 Annual conference of the Association of Computing Machinery (ACM-India)

The ACM-India conference consisted of a day of symposia for graduate students on Jan 22, a day of discussions on the theme of Women in Computing on the 23rd, and a day of perspective presentations on research in computer science on the 24th.

### 4.2.9 IMSc Outreach three day workshop: Introduction to Field Theory via Geometry and Number Theory

On each of the three days, there were two lectures in the morning, one by each resource person (D. S. Nagaraj and K. N. Raghavan), and two problem sessions in the afternoon, one conducted by each resource person. In all, there were six lectures and six problem sessions. One set of lectures was on finite fields and the other on ruler and compass constructions. Notes for the lectures were distributed and also uploaded on IMSc website (from where they are freely accessible).

The workshop was attended by sixty two Mathematics first year M. Sc. students of the university and neighbouring colleges, and also by the faculty and research scholars of the University. Certificates of participation were distributed to students and feedback solicited from them.

## 4.3 Seminars

| Date | Speaker<br>Affiliation | Title |
|---|---|---|
| 3-4-2012 | Holger Nielsen<br>Niels Bohr Institute, Copenhagen, Denmark | Anomaly and Dirac sea |
| 3-4-2012 | Sebastian Kuhnert<br>Humboldt University, Berlin | Canonical Representations for Circular Arc Graphs |
| 4-4-2012 | Vikram Soni<br>Jamia Milia University, New Delhi | Magnetars: New Stars, New Physics |
| 4-4-2012 | Shankhadeep Chakrabortty<br>IOP Bhubaneshvar | Correlators of Giant Gravitons from dual ABJ(M) Theory. |
| 4-4-2012 | Amritanshu Prasad<br>IMSc | Polynomial representations of GL(n): characters |
| 9-4-2012 | Assa Aravindh<br>IGCAR, Kalpakkam | Ab initio investigations on the Magnetic and Electronic properties of Fe-Co and Fe-Ni nanostructures |
| 9-4-2012 | Bikash Sinha<br>SINP, Kolkata | Dark Matter |
| 11-4-2012 | Justin R. David<br>IISc, Bangalore | Exact results for the BTZ black hole |
| 11-4-2012 | Sachin Sharma<br>IMSc | The t-analog of the basic string function for twisted affine Kac-Moody algebras |
| 16-4-2012 | Seema Satin<br>IMSc | Stochastic gravity and Noise Kernel |
| 16-4-2012 | Prateep Chakraborty<br>IMSc | Computing Cohomology algebras of certain spaces using fiber bundle |

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|---|---|---|
| 18-4-2012 | B Chandrasekar<br>IIT Bhubaneswar | Tunneling in AdS and Boundary Matrix Models |
| 18-4-2012 | R. Venkatesh<br>IMSc | Conjugacy classes of Coxeter Elements |
| 19-4-2012 | Arkadev Chattopadhyay<br>University of Toronto | A little advice can be very helpful |
| 19-4-2012 | Sridhar Anandakrishnan<br>Penn. State Univ., USA | Glacier and Ice Sheets in a Changing Climate |
| 21-4-2012 | Partha Mukhopadhyay, Sourav Chakraborty, CMI &<br>C.R. Subramanian, V.Arvind, IMSc | Randomization in computer science: Golden jubilee thematic lectures in TCS |
| 23-4-2012 | F. T. Farrell<br>SUNY, Binghamton | The failure of smooth rigidity and the best of all possible maps |
| 24-4-2012 | Amilcar R. de Queiroz<br>Instituto de Fisica, Universidade de Brasilia, Brazil | EDM from any $\theta$-QCD Vanishes for Mixed States |
| 25-4-2012 | Pooja Singla<br>IISc | Extensions of abelian groups and similarity of matrices |
| 26-4-2012 | Steven Spallone<br>TIFR | Discrete Series Characters, p-adic Orbital Integrals, and Modular Forms |
| 30-4-2012 | Nabyendu Das<br>IISc, Bangalore | Aspects of Quantum phase transition in ferroelectrics |
| 2-5-2012 | Gaurav Narain<br>IMSc | Short Distance Freedom of Quantum Gravity |
| 2-5-2012 | Steven Spallone<br>TIFR, Mumbai | An Integration Formula for Unipotent Radicals |
| 3-5-2012 | K V P Lata<br>Pondicherry University | CP violation with electric dipole moment of atomic mercury |
| 3-5-2012 | Vinod Gaur<br>IIA Bangalore | The Plate Tectonic Revolution |

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|---|---|---|
| 8-5-2012 | Sebastian Horvath<br>Dept of Physics and Astronomy, University of Canterbury, New Zealand | Amplitudes for space-like separations and causality |
| 10-5-2012 | Manu Basavaraju<br>IMSc | The Discharging Method |
| 11-5-2012 | Dharam Vir Ahluwalia<br>Dept of Physics and Astronomy, University of Canterbury, New Zealand | About neutrinos: from Pauli, to Pontecorvo, to Goldman, and things in between |
| 17-5-2012 | Saket Saurabh<br>IMSc | A tale of Simple Algorithm (Really :)) |
| 18-5-2012 | Ashutosh Rai<br>IMSc Chennai | Recent developments in lower bounds on kernelization |
| 18-5-2012 | Fahad Panolan<br>IMSc Chennai | Randomization in Parameterized Complexity via the k-path problem |
| 19-5-2012 | Venkatesh Raman, Arvind, Saket Saurabh, IMSc., & NarayanaSwamy, IIT Madras | Graphs: Explorations and Algorithms, Golden jubilee thematic lectures in TCS |
| 30-5-2012 | Rahul Sinha<br>IMSc | The beautiful and charming path to New Physics |
| 31-5-2012 | Ritwik Mukherjee<br>IMSc | Counting Curves via Topology |
| 7-6-2012 | Ravindra, G.V.<br>University of Missouri–St. Louis | Extension theorems for subvarieties and vector bundles. |
| 13-6-2012 | Sudipta Sarkar<br>IMSc | Zeroth Law for black holes |
| 15-6-2012 | Shyamashree Upadhyay<br>IIT Guwahati | The Hilbert-Kunz function of certain hypersurfaces |
| 15-6-2012 | Ashutosh Trivedi<br>UPenn, USA | Formal Design and Analysis of Cyber-Physical Systems |

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|---|---|---|
| 15-6-2012 | Anish Mallick<br>IMSc | Hilbert's Third Problem and Scissors Congruences |
| 22-6-2012 | Uday Bhaskar Sharma<br>IMSc | Frobenius-Schur Index |
| 23-6-2012 | Kamal Lodaya, R. Ramanujam, S. Sheerazuddin, IMSc & S.P. Suresh, CMI | Concurrency in the multicore age: Golden jubilee thematic lectures in TCS |
| 25-6-2012 | Nitin Saurabh<br>IMSc | Algebraic Models of Computation |
| 26-6-2012 | Samir Kunkri<br>Mahadevananda Mahavidyalaya, Barrackpore, West Bengal | Simulating the singlet state correlation with non-quantum resources |
| 26-6-2012 | Gaurav Rattan<br>IMSc | Spectral algorithms for some graph problems |
| 27-6-2012 | A P Balachandran<br>IMSc | Algebraic theory of entanglement |
| 28-6-2012 | Ravi Kunjwal<br>IMSc | Limits on nonlocal correlations from physical principles – a review |
| 28-6-2012 | Ashutosh Rai | Improved parameterized algorithms for split deletion problem |
| 29-6-2012 | Rekha Biswal<br>IMSc | Structure theorem for finitely generated modules over Dedekind domains |
| 2-7-2012 | R. Balaji<br>University of Colorado, USA | Sea Level Rise in a Changing Climate - Projections and Implications for Resource Management |
| 4-7-2012 | Vasudharani Devanathan<br>Group Leader-Cardiovascular Division, Institute for Pharmacology and Toxicology, University of Tubingen, Tubingen, Germany | Roles of G-alpha-i proteins in cardiovascular diseases-thrombosis and ischemia reperfusion injury |

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| 4-7-2012 | Jayadev S. Athreya<br>UIUC | Gap Distributions and Homogeneous Dynamics |
| 5-7-2012 | Lavanya Sivakumar<br>IMSc Chennai | Finding Edge-disjoint Trees in Graphs |
| 6-7-2012 | Pradeep Servepalli<br>Georgia Institute of Technology | Topological Subsystem Codes From Graphs and Hypergraphs |
| 6-7-2012 | Sudipta Kumar Basu<br>IMSc | Whitney embedding theorem |
| 9-7-2012 | Ayan Paul<br>University of Notre Dame | Prospects of Charm |
| 10-7-2012 | Kallol Sen<br>IISc, Bangalore | Exact holographic counter terms |
| 11-7-2012 | Dibyendu Das<br>IIT Bombay | Giant number fluctuations in interacting and growing microbial populations |
| 11-7-2012 | Bastien Maubert<br>IRISA, Rennes, France | Towards a notion of uniform strategies |
| 12-7-2012 | Michael Lau<br>Universite Laval | Affine Lie Algebras and their Friends and Neighbours |
| 12-7-2012 | Vinodchandran Variyam<br>University of Nebraska, Lincoln | On the Space Complexity of the Graph Reachability Problem |
| 14-7-2012 | Raman Nurani<br>DFMSim-India | Recent Trends in Semiconductor Manufacturing and Computational Complexity |
| 17-7-2012 | Shailesh Chandrasekharan<br>Duke University | Solutions to some unsolved sign problems in strongly correlated lattice fermion systems |
| 18-7-2012 | T Geetha<br>IMSc | Cellularity of wreath product algebras |
| 19-7-2012 | Sachin Gautam<br>Columbia University | Yangians and their Representations |

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| 19-7-2012 | Shakir Ali<br>Aligarh Muslim University | On commuting and centralizing mappings in rings and algebras |
| 19-7-2012 | N. S. Narayanaswamy<br>IIT Madras | Min-Cos-R is FPT |
| 20-7-2012 | Gagan Bihari Mohanty<br>TIFR, Mumbai | Experimenting with the Higgs – Recent Results from LHC |
| 21-7-2012 | K. Narayan Kumar, Madhavan Mukund, CMI, Supratik Chakraborty, IIT Bombay & R. Ramanujam, IMSc | Automata in the real world: Golden jubilee thematic lectures in TCS |
| 24-7-2012 | Anish Ghosh<br>University of East Anglia | Abundance of bounded orbits |
| 24-7-2012 | Aditya Bawane<br>IMSc | Project Presentation |
| 25-7-2012 | Anitha Thillaisundaram<br>HRI | The concept of p-deficiency and its applications |
| 26-7-2012 | Anish Ghosh<br>University of East Anglia | Homogeneous dynamics and number theory |
| 26-7-2012 | Kunal Dutta<br>IMSc | Concentration of Measure: A TCS perspective. |
| 27-7-2012 | Sachin Gautam<br>Columbia University | Difference Equations |
| 1-8-2012 | Vani Starry Manoharan<br>Argonne National Laboratory, Chicago, USA | Impact of human activities on climate change in the tropics |
| 6-8-2012 | Neeraj Kumar Kamal<br>IMSc, Chennai | Imbalance of positive and negative links induces regularity |
| 7-8-2012 | Mathew Francis<br>LIRRM, University of Montpellier, France | The maximum clique problem in multiple interval graphs |

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|---|---|---|
| 8-8-2012 | J Pasupathy<br>IISc, Bangalore | Heisenberg's road to quantum mechanics and influence of Einstein on Heisenberg |
| 9-8-2012 | Kumar Murty<br>University of Toronto | Bounded Generation |
| 9-8-2012 | Ramakrishna Nanduri<br>IMSc | Hilbert Coefficients of Schubert varieties in Grassmannians |
| 13-8-2012 | Ravishankar Krishnaswamy<br>Carnegie Mellon University | Approximation Techniques for Stochastic Optimization Problems |
| 13-8-2012 | G Rajasekaran<br>IMSc | Standard Model, Higgs boson and what next? |
| 14-8-2012 | Gauhar Abbas<br>IMSc | Extraction of strong coupling from hadronic tau decays |
| 14-8-2012 | M Sivapalan<br>University of Illinois at Urbana-Champaign | Predictions under Change: Water, Earth and Biota in the Anthropocene (Please note that the venue is shifted to Dept of Civil Engineering, IIT Madras) |
| 14-8-2012 | Arghya Mondal<br>IMSc | Automorphisms of Riemann Surfaces |
| 16-8-2012 | Sunita Vatuk<br>Rutgers University, USA | From three cultures, working together: mathematicians, math educators and teachers |
| 16-8-2012 | S Lakshmivarahan<br>University of Oklahoma | Dynamic Data Assimilation – An Overview |
| 17-8-2012 | Krishnaswami Alladi<br>University of Florida | Rogers-Ramanujan partitions and products modulo 6 and 7 |
| 20-8-2012 | Umesh Dubey<br>TIFR, Mumbai | Geometry of tensor triangulated categories |
| 21-8-2012 | Umesh Dubey<br>TIFR | Spectrum of tensor triangulated categories |

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| 21-8-2012 | Ayan Paul<br>University of Rome | Flavour in the Warped Extra Dimensions |
| 22-8-2012 | Ajit. M. Srivastava<br>Institute of Physics, Bhubaneswar | From The Universe to Relativistic Heavy-ion Collisions: CMBR Anisotropies and Flow Fluctuations |
| 22-8-2012 | Markus Blaeser<br>Saarland University, Germany | Algebraic Complexity Theory: Models, Problems, Challenges |
| 22-8-2012 | K N Raghavan<br>IMSc | Representation theory Seminar: Intro to symmetric polynomials |
| 22-8-2012 | P. Sankaran<br>IMSc | Characteristic classes |
| 23-8-2012 | I Karthik<br>IMSc | Generalized Attractors in Five-Dimensional Gauged Supergravity |
| 25-8-2012 | R. Ramanujam, Kamal Lodaya, Sitabhra Sinha, IMSc & S.P. Suresh, CMI | A Celebration of Turing: Golden jubilee thematic lectures in TCS |
| 27-8-2012 | Andreas Krebs<br>Univ Tubingen, Germany | Dense Completeness |
| 29-8-2012 | K N Raghavan<br>IMSc | Symmetric functions, Schur functions : RT Seminar |
| 29-8-2012 | P. Sankaran | Characteristic classes |
| 30-8-2012 | K Narayan<br>CMI, Chennai | Lifshitz scaling and hyperscaling violation in string theory |
| 30-8-2012 | Amritanshu Prasad<br>IMSc | Similarity Classes of Matrices |
| 30-8-2012 | Kamal Lodaya | Probabilistic systems and their verification |
| 3-9-2012 | Kabir Ramola<br>TIFR, Mumbai | Columnar Order and Ashkin-Teller Criticality in the Hard Square Lattice Gas |

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| 5-9-2012 | R Parthasarathy<br>Bharatiar University, Coimbatore | Harish-Chandra's Construction of Discrete Series Characters: 'Global - Infinitesimal' transfer: RT Seminar |
| 6-9-2012 | Helmut Seidl<br>Tech Univ Muenchen, Germany | Abstract Interpretation meets Mathematical Optimization |
| 6-9-2012 | V. Arvind | On generating hard SAT instances |
| 7-9-2012 | R Parthasarathy<br>Bharatiar University, Coimbatore | RT Seminar: Harish-Chandra's Construction of Discrete Series Characters: 'Global - Infinitesimal' transfer |
| 7-9-2012 | T. Mubeena<br>IMSc | Residually finite groups |
| 10-9-2012 | Argha Banerjee<br>IMSc. | The response of Himalayan Glaciers to Climate Change |
| 10-9-2012 | Sathya Peri<br>IIT, Patna | Correctness of Closed Nesting in Software Transactional Memory Systems |
| 12-9-2012 | Arif Mohd<br>Dept. of Physics, University of Mississippi/SISSA, Italy | Black-hole entropy in first-order gravity |
| 12-9-2012 | R Venkatesh<br>IMSc | New interpretation of Chromatic Polynomials using Kac-Moody algebras |
| 13-9-2012 | Ramanujam | Introducing Large Games |
| 14-9-2012 | Balachandran Sathiapalan<br>IMSc | Loop Variables and Gauge Invariant Exact Renormalization Group Equations for (Open) String Theory |
| 14-9-2012 | Pampa Paul<br>IMSc | Harish-Chandra homomorphism and its applications. |
| 15-9-2012 | Meena Mahajan, Vikram Sharma, IMSc &<br>Prajakta Nimbhorkar, CMI | Matchings in Graphs: Golden jubilee thematic lectures in TCS |

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| 17-9-2012 | P. Sankaran<br>IMSc | Characteristic classes |
| 18-9-2012 | Rajaram Nityananda<br>TCIS Hyderabad, NCRA-TIFR, Pune | Unifying the evolution of phases of optical beams under changes of both direction and polarisation |
| 18-9-2012 | Pampa Paul<br>IMSc | Discrete series and their Harish-Chandra modules |
| 20-9-2012 | Pampa Paul<br>IMSc | Borel de Siebenthal and holomorphic discrete series |
| 20-9-2012 | Sreejith | An introduction to Descriptive complexity |
| 24-9-2012 | Krishanu Dan<br>IMSc | Unimodular Row Extension Property of $k[x_1, x_2, ..., x_n]$, where k is a field. |
| 25-9-2012 | P. Sankaran<br>IMSc | Characteristic classes |
| 26-9-2012 | A P Balachandran<br>IMSc and Syracuse University | Algebraic Quantum Physics |
| 26-9-2012 | Uday Bhaskar Sharma<br>IMSc | Multiplicity-free Restrictions for Symmetric Groups |
| 27-9-2012 | Yadu | How to learn an unknown concept? |
| 28-9-2012 | Sushanta Dattagupta<br>Viswa-Bharati, Santiniketan | Partial Decoherence of a Mesoscopic System |
| 1-10-2012 | Chandrashekar Madaiah<br>University College Cork, Ireland | Two-state quantum walk on different lattices and its applications |
| 1-10-2012 | P. Sankaran<br>IMSc | Characteristic classes |
| 3-10-2012 | Alok Laddha<br>CMI, Siruseri | Space-time covariance in Loop Quantum gravity |
| 3-10-2012 | Anupam Singh<br>IISER Pune | Strongly Real Classes in finite Unitary groups |

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| 4-10-2012 | J. Oesterle<br>University of Paris VI | Panorama lectures on Multiple zeta values |
| 4-10-2012 | A Raghuram<br>IISER, Pune | From Calculus to Number Theory (via cohomology) |
| 4-10-2012 | R. Vidya<br>Center for Materials Science and Nanotechnology University of Oslo, Norway. | Understanding role of defects in ZnO using density-functional calculations |
| 4-10-2012 | Ashutosh | OR Conjecture and its proof |
| 5-10-2012 | J. Oesterle<br>University of Paris VI | Panorama lectures on Multiple zeta values |
| 8-10-2012 | J. Oesterle<br>University of Paris VI | Panorama lectures on Multiple zeta values |
| 8-10-2012 | Prateep Chakraborty<br>IMSc | Bockstein Homomorphism and some applications |
| 10-10-2012 | S Senthamaraikannan<br>Chennai Mathematical Institute | A Vanishing Result on Cohomology of line bundles on Schubert Varities |
| 10-10-2012 | Sourish Kumar Maitra<br>IMSc | Interpretations about non locality, gravity and quantum measurement |
| 10-10-2012 | J.Oesterle<br>University of Paris VI | Panorama lectures on Multiple zeta values |
| 11-10-2012 | Debraj Chakrabarti<br>TIFR CAM | Holomorphic Maps |
| 11-10-2012 | P. Sankaran<br>IMSc | Characteristic classes |
| 11-10-2012 | Karteek | Power of negations |
| 12-10-2012 | J. Oesterle<br>University of Paris VI | Panorama lectures on Multiple zeta values |
| 15-10-2012 | Madhushree Basu<br>IMSc | Free product of finite dimensional non-commutative probability spaces |

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| 16-10-2012 | J. Oesterle<br>University of Paris VI | Panoram lectures on Multiple zeta values |
| 16-10-2012 | J. Oesterle<br>University of Paris VI | Panorama lectures on Multiple zeta values |
| 17-10-2012 | Mridupawan Deka<br>JINR, Dubna | Quark and gluon angular momenta from lattice QCD |
| 17-10-2012 | S Senthamaraikannan<br>CMI | A Vanishing Result on Cohomology of line bundles on Schubert Varities |
| 17-10-2012 | P. Sankaran<br>IMSc | Characteristic classes |
| 18-10-2012 | J. Oesterle<br>University of Paris VI | Panorama lectures on Multiple zeta values |
| 18-10-2012 | Mamata Sahoo<br>Max Planck Institute of Colloids and Interfaces, Germany | Driven non-equilibrium systems and biological processes like transcriptional proofreading in dense RNA polymerase traffic |
| 20-10-2012 | Sasanka Roy, CMI, John Augustine, IIT Madras & Vikram Sharma, IMSc | Computational Geometry: Searching for a nearest neighbour - Golden jubilee thematic lectures in TCS |
| 20-10-2012 | J. Oesterle<br>University of Paris VI | Oscillating series by Ramanujan |
| 23-10-2012 | J. Oesterle<br>University of Paris VI | Panorama lectures on Multiple zeta values |
| 23-10-2012 | Arnab Kundu<br>University of Texas, Austin | Dynamics of Fundamental Flavours and Holographic Duals of Large N Gauge Theories. |
| 23-10-2012 | C. P. Anil Kumar<br>IMSc | A new approach to representation theory of symmetric groups. |
| 25-10-2012 | Bhaswar Ghosh<br>Computational Systems Biology Lab, EPFL, Lausanne, Switzerland | Divergent promoter architectures employed by the co-regulated budding yeast ribosomal protein genes |

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| 25-10-2012 | J. Oesterle<br>University of Paris VI | Panorama lectures on Multiple zeta values |
| 25-10-2012 | Yann Strozecki<br>Univ of Versailles, France | Methods for enumeration |
| 25-10-2012 | P. Sankaran<br>IMSc | Characteristic classes |
| 27-10-2012 | J. Oesterle<br>Paris VI | On a problem sent by Ramanujan to the journal of the Indian mathematical society |
| 29-10-2012 | Sudarshan Gurjar<br>IMSc | Finite generation of the ring of invariants and the problem of quotients |
| 30-10-2012 | J. Oesterle<br>University of Paris VI | Panorama lectures on Multiple zeta values |
| 31-10-2012 | Amritanshu Prasad<br>IMSc | Combinatorial rule for multiplication in Schur algebras |
| 31-10-2012 | P. Sankaran<br>IMSc | Characteristic classes |
| 1-11-2012 | J. Oesterle<br>University of Paris VI | Panoram lectures on Multiple zeta values |
| 1-11-2012 | Safdar Quddus<br>Washington University, St. Louis | On the cohomology of non-commutative toric orbifolds. |
| 1-11-2012 | Mathew Francis | The boxicity and cubicity of graphs |
| 3-11-2012 | Joseph Oesterle<br>University of Paris VI | On equations of degree three |
| 5-11-2012 | Satyajit Guin<br>IMsc | Universal central extensions and Milnor's $K_2$ |
| 6-11-2012 | J. Oesterle<br>University of Paris VI | Panorama lectures on multiple zeta values |

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|---|---|---|
| 6-11-2012 | P. Sankaran<br>IMSc | Characteristic classes |
| 7-11-2012 | Jeanne Scott<br>IMSc | Promotion, Sieving, and Mixing (RT Seminar) |
| 7-11-2012 | Chandan Dasgupta<br>Physics Department, Indian Institute of Science, Bangalore | Structure and dynamics of water molecules confined in carbon nanotubes |
| 8-11-2012 | J. Oesterle<br>University of Paris VI | Panorama lectures on Multiple zeta values |
| 8-11-2012 | Nicolas de Rugy-Altherre<br>University of Paris-Diderot | Generating functions : a hard case |
| 10-11-2012 | J. Oesterle<br>University of Paris VI | On continued radicals |
| 12-11-2012 | J. Oesterle<br>University of Paris VI | Panorama lectures on Multiple zeta values |
| 12-11-2012 | B. Ravinder<br>IMSc | Gelfand-Tsetlin basis for the irreducible representation of $sl_n + 1$ |
| 15-11-2012 | J. Oesterle<br>University of Paris VI | Panorama lectures on Multiple zeta values |
| 15-11-2012 | S. Ramakrishna<br>North Western University | Rotational wave packet imaging of molecules |
| 16-11-2012 | M. Farooq Azam<br>IRD-LTHE-LGGE, Grenoble, France | Status of Himalayan Glaciers in India, A case Study of Chhota Shigri glacier, HP |
| 17-11-2012 | J. Oesterle<br>University of Paris VI | On dynamical system |
| 19-11-2012 | Dhriti Ranjan Dolai<br>IMSc | The density of states |
| 20-11-2012 | J. Oesterle<br>University of Paris VI | Panorama lectures on Multiple zeta values |

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| 20-11-2012 | Si Si<br>Aichi Prefectural University | Some recent topics in white noise theory |
| 21-11-2012 | J. Oesterle<br>University of Paris VI | Panorama lectures on Multiple zeta values |
| 21-11-2012 | Sumedha<br>NISER, Bhubaneswar | Some results on random K-Satisfiability problem on trees |
| 21-11-2012 | S Viswanath<br>IMSc | RT Seminar: Gelfand-Tsetlin Patterns |
| 21-11-2012 | P. Sankaran<br>IMSc | Characteristic classes |
| 24-11-2012 | Saket Saurabh, Manu Basavaraju, Fahad Panolan & Pranabendu Misra, IMSc | Matroids and Algorithms: Golden Jubilee Thematic Lectures in TCS |
| 27-11-2012 | Shailesh Lal<br>ICTS | Partition Functions for Higher Spin Fields in AdS |
| 28-11-2012 | Akhilesh Nautiyal<br>IMSc | Non-standard models of inflation |
| 28-11-2012 | Amritanshu Prasad<br>IMSc | The hook-length formula |
| 29-11-2012 | Sarbeshwar and Vaibhav<br>CMI and IMSc | Algebraic geometry |
| 29-11-2012 | Sreejith | Non-definability of languages by generalized first-order formulas over (N,+) |
| 30-11-2012 | Sutapa Roy<br>JNCASR, Bangalore | Dynamics of fluid-fluid criticality |
| 3-12-2012 | Ronnie Sebastian<br>IMSc | Smash nilpotent cycles on varieties dominated by products of curves |

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| 5-12-2012 | Christian Thaulow<br>Department of Engineering Design and Materials, Norwegian University of Science and Technology, Trondheim, Norway | Learn Engineering from Nature |
| 7-12-2012 | Gaurav Narain<br>IMSc | Charge Renormalization due to Graviton Loops |
| 7-12-2012 | Rahul Cherian<br>Inclusive Planet Centre for Disability Law and Policy | Copyright Exceptions for Persons with Disabilities and opportunities for libraries |
| 10-12-2012 | Saptarshi Mandal<br>IACS, Kolkata | Superfluid-insulator transition of two-species bosons with spin-orbit coupling |
| 10-12-2012 | Tom Kibble<br>Imperial College, UK | What is the Higgs? What is it for? |
| 11-12-2012 | Harald Fritzsch<br>Ludwig-Maximilians-Universitt, Germany | Quantum Chromodynamics |
| 12-12-2012 | J. Oesterle<br>University of Paris VI | Multiple zeta values |
| 12-12-2012 | M. Ram Murty<br>Queen's University, Canada | Automorphy and the Sato-Tate Conjecture |
| 13-12-2012 | Sanming Zhou<br>The University of Melbourne, Australia | Distance labellings of graphs |
| 14-12-2012 | Hai-Yang Cheng<br>Institute of Physics, Academia Sinica, Taipei | Direct CP violation in D decays |
| 14-12-2012 | Harald Fritzsch<br>Ludwig Maximilian University | Escape from Leipzig |
| 14-12-2012 | Andr de Gouvea<br>Northwestern University | Muon physics, relation to neutrinos and other physics beyond the standard model |

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| 14-12-2012 | Boris J Kayser<br>Fermilab | Leptogenesis as the Origin of the Cosmic Matter-Antimatter Asymmetry |
| 19-12-2012 | Stephen Olsen<br>Seoul National University | The XYZ mesons, recent results & current status |
| 20-12-2012 | E. Prabhu Raman<br>Computer Aided Drug Design Center Univ. of Maryland School of Pharmacy | Computational Methods for Structure Based Drug Design |
| 20-12-2012 | GSMoni & Sitabhra<br>IMSc | Faculty Development Programe. Dhanalakshmi College of Engineering |
| 21-12-2012 | Uday Bhaskar Sharma<br>IMSc | The Okounkov-Vershik Approach to Representation Theory |
| 22-12-2012 | V. Arvind, C.R. Subramanian, IMSc V. Sunitha, DAIICT, Gandhinagar &<br>N.S. Narayanaswamy, IIT Madras | Network Flows: Golden jubilee thematic lectures in TCS |
| 24-12-2012 | Chandler Davis<br>Univ. of Toronto, Canada | A representation theorem for operators |
| 24-12-2012 | Manoj Gopalkrishnan<br>STCS, TIFR Mumbai | Physics of the bit |
| 25-12-2012 | J. Oesterle<br>University of Paris VI | Multiple zeta values |
| 26-12-2012 | Sameer Murthy<br>Nikhef theory group, Amsterdam | Mock theta functions and their appearance in physics |
| 27-12-2012 | Janu Verma<br>Kansas State Univ | Geometry of quiver representations, Kac Conjecture and Donaldson - Thomas Invariants |

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| 28-12-2012 | Arnab Chatterjee<br>Department of Biomedical Engineering and Computational Science (BECS), Aalto University School of Science, Espoo, Finland | Universality in collective opinion: the voting case |
| 1-1-2013 | Aditya Date<br>IIT Kharagpur | Coherent Back Scattering of Ultra Cold Atoms |
| 1-1-2013 | J. Oesterle<br>University of Paris VI | Multiple zeta values |
| 4-1-2013 | George Sterman<br>Yang Institute for Theoretical Physics, Stony Brook | Aspects of Resummation |
| 5-1-2013 | J. Oesterle<br>University of Paris VI | Multiple zeta values |
| 7-1-2013 | Leonid Pastur<br>Department of Low Temperature Physics, Kharkov, Ukrain | On Links Between the Random Operator and Random Matrix Theories |
| 7-1-2013 | Amitabha Nandi<br>Department of Molecular, Cellular and Developmental Biology, Yale University, | Regulated tissue fluidity steers zebrafish body elongation |
| 7-1-2013 | P. Sankaran<br>IMSc | Characteristic classes |
| 8-1-2013 | Leonid Pastur<br>Department of Low Temperature Physics, Kharkov, Ukrain | On Links Between the Random Operator and Random Matrix Theories |
| 8-1-2013 | V.Parameswaran Nair<br>City College of the CUNY, New York, USA | A matrix model for Yang-Mills amplitudes and color-kinematic duality |
| 8-1-2013 | J. Oesterle<br>University of Paris VI | Multiple zeta values |

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| 9-1-2013 | Smitha Vishveshwara<br>University of Illinois at Urbana-Champaign | Fractionalization in Mesoscopic Rings |
| 9-1-2013 | Prashanth Jaikumar<br>California State University, Long Beach | A numerical investigation of the quark-hadron phase transition in neutron stars |
| 9-1-2013 | J. Oesterle<br>University of Paris VI | Multiple zeta values |
| 9-1-2013 | Henning Krause<br>University of Bielefeld | Quiver representations, exceptional sequences, and noncrossing partitions |
| 10-1-2013 | Ganesh Ramachandran<br>Institute for Theoretical Solid State Physics, Dresden | Frustrated magnetism on the honeycomb lattice |
| 10-1-2013 | Kamalakshya Mahatab<br>IMSc | Counting Primes in Semirings |
| 10-1-2013 | Sridhara Dasu<br>University of Wisconsin | Search for Neutral Higgs bosons that Decay to tau-pairs |
| 10-1-2013 | J. Oesterle<br>University of Paris VI | Multiple zeta values |
| 11-1-2013 | Pinaki Chaudhuri<br>Institute for Theoretical Physics II (Soft Matter), University of Dusseldorf, Germany | Yielding and flow of confined jammed materials |
| 11-1-2013 | Balaji Rajagopalan<br>University of Colarado | The Tibetan Plateau, Sun and, the Indian Monsoon Rainfall |
| 11-1-2013 | P. Sankaran<br>IMSc | Representations of real semisimple Lie groups |
| 15-1-2013 | Sheerazuddin<br>IMSc | Automata and logic for systems with unboundedly many agents |
| 15-1-2013 | P. Sankaran<br>IMSc | Characteristic classes |

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| 16-1-2013 | Sridhar Mahadevan<br>University of Massachusetts, Amherst | Nonlinear Transfer Learning Across High-Dimensional Datasets |
| 16-1-2013 | Amritanshu Prasad<br>IMSc | Counting quiver representations over finite fields |
| 16-1-2013 | P. Sankaran<br>IMSc | Representations of real semisimple Lie groups |
| 16-1-2013 | Paritosh Pandya<br>TIFR | From Unary to Determinstic Logics for UL |
| 17-1-2013 | Kamalakshya Mahatab<br>IMSc | The Multiplication Table Problem |
| 17-1-2013 | V K Madan<br>School of Electrical and Communication Sciences ,<br>Kalasalingam University ,<br>Krishnankoil, Virudhunagar | Digital Signal Processing (DSP): From Plato to Looking Forward. |
| 21-1-2013 | P. Sankaran<br>IMSc | Characteristic classes |
| 22-1-2013 | Issan Patri<br>IMSc | From compact groups to compact quantum groups |
| 23-1-2013 | Amritanshu Prasad<br>IMSc | The cycle index for groups of matrices |
| 25-1-2013 | P. Sankaran<br>IMSc | Lie groups seminar |
| 29-1-2013 | Arghya Mondal<br>IMSc | Exotic sphere embedded in complex hupersurface |
| 30-1-2013 | P. Corvaja<br>University of Udine | Sharpening of Manin-Mumford |
| 30-1-2013 | Jeanne Scott<br>IMSc | Generalised flag varieties and their Poincare polynomials |
| 31-1-2013 | Kashyap Rajeevsarathy<br>IISER Bhopal | On the fractional powers of Dehn twists |

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| 31-1-2013 | Pushan Majumdar<br>IACS, Kolkata | GPU computing : First Experiences |
| 1-2-2013 | P. Corvaja<br>University of Udine | Around Hilbert Irreducibility Theorem |
| 1-2-2013 | P. Sankaran<br>IMSc | Characteristic classes |
| 5-2-2013 | Movie on Manin by Handwerk and Willems<br>Free journalists, Hamburg and Amsterdam | Documentary film about Yuri Manin |
| 5-2-2013 | Movie on Doeblin by Handwerk and Willems<br>Free journalists, Hamburg and Amsterdam | Documentary film about Wolfgang Doeblin |
| 5-2-2013 | Kamalakshya Mahatab<br>IMSc | Number of prime factors in an integer |
| 6-2-2013 | Steven G. Avery<br>IMSc | Unitarity, Firewalls, and Fuzzballs |
| 6-2-2013 | Jeanne Scott<br>IMSc | Generalised flag varieties and their multivariate Poincare polynomials |
| 8-2-2013 | Steven G. Avery<br>IMSc | Unitarity, Firewalls, and Fuzzballs - Continued |
| 13-2-2013 | Manjunath Krishnapur<br>IISc, Bangalore | Random Matrices a crash course |
| 13-2-2013 | G. Baskaran<br>IMSc | Superradiant Superconductivity - a Novel Electronic State |
| 13-2-2013 | S. Viswanath<br>IMSc | Hall-Littlewood polynomials |
| 14-2-2013 | Pascal Weil<br>LaBRI, CNRS, and Université de Bordeaux | The FO2 quantifier alternation hierarchy is decidable |

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| 14-2-2013 | W. Kohnen<br>University of Heidelberg | Conic theta functions |
| 14-2-2013 | Priyotosh Bandyopadhyay<br>University of Helsinki | Higgs physics beyond standard model in the light of LHC results. |
| 14-2-2013 | Navinder Singh<br>Physical Research Laboratory, Ahmedabad | Yang-Rice-Zhang theory of Normal State of cuprate superconductors |
| 15-2-2013 | K Balagopal<br>IIT Madras | Pebbling, Entropy and Branching program size lower bounds |
| 15-2-2013 | John Ellis (Live video stream)<br>King's College, London and CERN | Answering Gauguin's Question with the LHC |
| 19-2-2013 | Dibyakrupa Sahoo<br>IMSc | Measuring the Spin, Parity & Couplings of The 125-126 GeV Boson |
| 20-2-2013 | A P Balachandran<br>IMSc and Syracuse University | QED: Spontaneous Lorentz Breaking |
| 20-2-2013 | S. Viswanath<br>IMSc | Hall-Littlewood polynomials |
| 25-2-2013 | P. Sankaran<br>IMSc | Characteristic classes |
| 26-2-2013 | Kamalakshya Mahatab<br>IMSc | Ford's lower bound on H(x, y, 2y) and Multiplication Table |
| 27-2-2013 | Arnab Rai Choudhuri<br>Physics Department, IISc, Bangalore | Can we predict sunspot cycles? |
| 28-2-2013 | P. K. Mohanty<br>SINP, Kolkata | Does an independent Manna universality class exist? |
| 28-2-2013 | Ankit Sharma<br>Carnegie Mellon University | Welfare and Profit maximization with Procurement costs |
| 28-2-2013 | J.M. Deshouillers<br>Université de Bordeaux | Sums of digits |

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| 1-3-2013 | Maury Goodman<br>ANL, USA | Status of NoVa and LBNE neutrino experiment |
| 4-3-2013 | Pierre Matsumi<br>IMSc | Mordell-conjecture, Fermat's last theorem, abc-conjecture |
| 4-3-2013 | P. Sankaran<br>IMSc | Characteristic classes |
| 5-3-2013 | Jyotipratim Ray Chaudhuri<br>Department of Physics, Katwa College, Katwa, Burdwan, West Bengal, India | Stochastic dynamics of high-frequency modulated quantum particle |
| 5-3-2013 | Biswambhar Pahi<br>ICPR National Fellow | Making constructive use of history: Groundwork for a Nyaya-Vaisesika philosophy of mathematics |
| 6-3-2013 | P. K. Manoharan<br>Radio Astronomy Centre (TIFR), Ooty | Evolution of 3-D Solar Wind During Solar Cycles: Are we heading for a Little Ice Age ? |
| 6-3-2013 | T. Geetha<br>IMSc | Schur-Weyl duality for Simplectic and orthogonal group. |
| 7-3-2013 | Kamalakshya Mahatab<br>IMSc | Diluted Multiplication Table Problem |
| 7-3-2013 | Samirnath Mallik<br>SINP | Effective field theory of strong interactions |
| 11-3-2013 | Pierre Matsumi<br>IMSc | From Shafarevich conjecture to Mordell conjecture |
| 11-3-2013 | Samirnath Mallik<br>SINP Kolkata | Chiral perturbation theory I |
| 12-3-2013 | Samirnath Mallik<br>SINP Kolkata | Chiral perturbation theory II |
| 18-3-2013 | Pierre Matsumi<br>IMSc | From Tate conjecture to Shafarevich conjecture |
| 20-3-2013 | Pablo Solis<br>UC Berkeley | A Wonderful Embedding of the Loop Group |

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| 21-3-2013 | Abhiram Soori<br>Physics Department, IISc, Bangalore | Transport across a junction of topological insulators and a superconductor |
| 25-3-2013 | Pierre Matsumi<br>IMSc | Proof of Tate conjecture |
| 26-3-2013 | M.C. Kumar<br>Institut fuer Theoretische Physik, Universitaet Hamburg, Germany | Threshold corrections to inclusive jet production at hadron colliders. |
| 26-3-2013 | Rajat Mittal<br>University of Waterloo | Helping quantum computers classically |
| 27-3-2013 | N. D. Hari Dass<br>CMI | Some Surprises from Particle Physics |
| 27-3-2013 | T. Geetha<br>IMSc | Schur-Weyl duality for Symplectic and orthogonal group. |
| 28-3-2013 | Pragya Srivastava<br>Raman Research Institute | Patterning of polar active filaments on curved membrane surfaces and active deformation of the cell membrane. |

# Chapter 5

# External Interactions

## 5.1 Collaborative Projects with Other Institutions

### 5.1.1 Algorithms and Complexity of Algebraic problems

The focus of this project is on algorithms and complexity theoretic questions for algebraic problems; more specifically, on identity testing problems, arithmetic circuit lower bounds, and isomorphism problems.

The project is funded by the Indo Max Planck Centre for Computer Sciences (IMPECS). The principal investigators include V Arvind and Meena Mahajan from IMSc, and Markus Bläser and B V Raghavendra Rao from Saarland University, Germany, and runs for a duration of 5 years beginning April 2011.

### 5.1.2 Arithmetic circuits computing polynomials

The aim of this project is to better understand arithmetic circuit computations of polynomials and related counting and enumeration complexity questions.

The project is funded by the Indo-French Centre for the Promotion of Advanced Research (IFCPAR/CEFIPRA). The principal investigators are Meena Mahajan from IMSc, and Guillaume Malod from Institut Mathmatique de Jussieu, Universit Paris Diderot, Paris 7, and the project runs for a duration of 3 years beginning May 2012.

### 5.1.3 Developing tools for dynamical modeling of C. elegans neuronal network activity

*Caenorhabditis elegans* is the only organism with its nervous system completely mapped. In addition to being small and well-characterized, its genetic amenability has made it an ideal system to study a whole animals behavior at the molecular and cellular levels. While the complete mapping of neuronal connections allows one to know the structural aspects of connectivity among neurons, there exists little information as to how the activities of individual neurons might correlate with particular behavioral patterns. This project intends to construct a dynamical neural network simulator for the entire C. elegans somatic nervous system using physiologically realistic single-compartment models of individual neurons. This will allow connecting electrical activity at the level of individual neurons to the behavior of the organism in response to specific stimuli, something which is experimentally still challenging. This will also permit prediction of hitherto unidentified neuronal members of specific behavioral circuits from activity patterns of the network. To verify the predictions obtained from the results of the model simulations, C.elegans strains with cameleon-labeled dopaminergic neurons for dynamical calcium imaging will be developed. The further aim of this proposal is to image and investigate activity-induced calcium changes in core cells of specific behavioral circuits.

### 5.1.4 DINO (Darkmatter@INO)

Work on the MiniDINO with a 30Kg Si detector is proceeding at SINP and IITB. It will be mounted in the UCIL mines at Jaduguda.

### 5.1.5 Fracture and Flow in Porous Media: Application in Geothermal Installation, Hydrocarbon Production and CO2 Storage.

Rock far beneath the earths surface can be fractured to allow for better flow-through. More fundamental knowledge is the key to environmental applications such as improving the utilization of terrestrial heat and acquiring more space for CO2 storage. This knowledge will also be useful for extracting more natural gas from the reservoirs.

The project partners are SINTEF Petroleum Research, Norway, Norwegian University of Science and Technology, Saha Institute of Nuclear Physics and S.N. Bose National Centre for Basic Sciences. The project is funded by the Research Council of Norway under the Research cooperation with India (INDNOR) project scheme.

### 5.1.6 India-based Neutrino Observatory (INO)

INO Project: A status summary

INO pre-project works have started. The formalities for obtaining land at Theni for the underground site, and at Madurai for setting up the so called "Inter-institutional Centre for High Energy Physics" have been completed. Tenders have been issued for topo survey and fencing work at both these places. The state Highways has begun work related to providing proper road access to the underground site. The TWAD board has commenced work related to providing water supply to the site. A temporary buiding near the site at Madurai has been rented to begin the activities of the ICHEP. IMSc group contributed significantly in all the above initiatives.

In addition the IMSc members continue to contribute to the physics and simulations group. In particular the resolution studies on muons and hadrons in ICAL detector have been completed and the papers are getting ready for submission. Related Physics papers are also getting ready. A physics and simulations white paper is getting ready for which IMSc members have made important contributions.

IMSc has also assisted in establishing a detector laboratory at IIT.

IMSc members have taken major initiatives in conducting many outreach programs in Madurai, Theni, Coimbatore and Kerala regions.

The scientific members of the IMSC-INO group are: D. Indumathi, M.V.N Murthy, G. Rajasekaran, Nita Sinha, S Lakshmi Mohan, K Meghna, Sumanta Pal.

Sri R. Sundarasrinivasan continues as Project Consultant working from Madurai.

### 5.1.7 Indo-German research grant funded by the Humboldt Foundation

This is a three year research grant funded by the Humboldt Foundation that supports research visits between research groups in Humboldt University, Berlin and IMSc. The project proposal is mainly on the Graph Isomorphism problem. The principal investigators for the two sides are Johannes Koebler and V. Arvind.

### 5.1.8 Indo-UK Joint Project

A joint project on above guarantee kernelization with Prof. Gregory Gutin and his group at Royal Hollway, University of London. Funded by British Royal Society.

### 5.1.9 Molecular Dynamics on Ionic Liquids

Presently Tanmay Mitra is working with Prof. Satyavani Vemparala, on MD study of pure Ionic Liquid-[BMIM][PF6] and its behaviour in water. It's an ongoing project for completion of M.Sc thesis.

## 5.2 Conference Participation and Visits to Other Institutions

**Amrutiya, Sanjay**

Participated in *Annual Foundation School -III* held at Harish-Chandra Research Institute, Allahabad during Jul 6 – Jul 31, 2012. Gave 2 Lectures on “Vector Bundles” and conducted 6 Tutorials

Participated in *International Conference on Algebraic Geometry* held at Indian Institute of Science, Bangalore during Dec 1 – Dec 3, 2012.

Participated in *Advanced Instructional School on Aspect of Galois Theory* held at Harish-Chandra Research Institute, Allahabad during Dec 10 – Dec 29, 2012. Gave 2 Lectures on Introduction to Schemes and conducted 18 Tutorials

Participated in *International Conference on Analytic and Algebraic geometry related to bundles* held at Kerala School of Mathematics, Kozhikode during Mar 25 – Mar 29, 2013. Presented a paper titled “Moduli of equivariant sheaves and Kronecker-McKay modules”

**Aravindh, Assa S.**

Participated in *School on Numerical Methods for Materials Science Related to Renewable Energy Applications* held at ICTP Trieste, ITALY during Nov 26 – Nov 30, 2012. This workshop contained both lectures and hands on sessions on QUANTUM ESPRESSO and related codes.

**Balakrishnan, Radha**

Participated in *National Conference on Perspectives in Physics* held at Department of Theoretical Physics, University of Madras, Chennai during Aug 10 – Aug 11, 2012. Gave an invited talk on Solitons in a strongly repulsive Bose-Einstein condensate.

**Balasubramanian, R.**

Participated in *International conference on Special functions and their applications 2012* held at SVN institute of technology, Surat during Jun 27 – Jun 29, 2012. Guest of honour and delivered a lecture

Participated in *National Workshop on Cryptology 2012* held at VIT University, Vellore on Aug 6, 2012. Inaugural Address and gave a Talk

Visited Indian Institute of Science, Bangalore on Oct 25, 2012. Delivered a talk on Ramanujan, in the Chemical Engineering Department

Visited Kendriya Vidyalaya , AFS Tambaram on Nov 3, 2012. Chief guest of the valedictory programme of regional level Science and Mathematics exhibition

Participated in *International Conference on History and Devolopement of Mathematical Sciences* held at Maharishi Dayanand University, Rohtak during Nov 21 – Nov 24, 2012. Guest of honour and delivered a lecture on Srinivasa Ramanujan

Participated in *Emerging Applications of Information Technology(EAIT 2012)* held at ISI, Kolkata on Nov 30, 2012. Guest of Honor and delivered a talk on "Partition Functions".

Participated in *VIJYOSHI(Vigyan Jyoti Shivir) Program* held at Indian Institute of Science, Bangalore during Dec 1 – Dec 3, 2012. Lecture on "An Introduction to Additive Number Theory"

Participated in *International Conference on Algebraic Geometry* held at Indian Institute of Science, Bangalore during Dec 2 – Dec 3, 2012. Inaugurated the function.

Participated in *Indocrypt* held at Indian Statistical Institute, Kolkata during Dec 9 – Dec 12, 2012. Session Chair

Participated in *National Seminar on Logic, Peano Axims and Number Theory (NSLPANT-2012)* held at Indian Statistical Institute, Kolkata on Dec 14, 2012. Keynote Address: "On Srinivasa Ramanujan"

Participated in *National Seminar on Algebra and analysis- Gateway to Modern technology* held at Meenakshi college for women, Chennai during Jan 29 – Jan 30, 2013. Inagurated the conference

Participated in *Functional Analysis Seminar, Nagercoil* held at Scott Christian College, Nagercoil during Jan 31 – Feb 2, 2013. Lectures on Functional Analysis

Participated in *National Science Day function* held at Structural Engineering Research Centre, CSIR Complex, Chennai on Feb 28, 2013. Cheif guest and delivered a lecture Cryptology : An application of Number theory to secure communications

Participated in *National Workshop on Ramanujan Graphs* held at University of Pune during Mar 11 – Mar 14, 2013. Lecture on Ramanujan Conjectures on weight 2 Cusp forms

**Basu, Madhushree**

Participated in *Instructional Workshop on Subfactors and Planar Algebras* held at Institute of Mathematical Sciences, Chennai during Mar 26 – Apr 3, 2012.

Visited Saarland University, Saarbrucken, Germany during Apr 15 – May 31, 2012. Discussions with Prof. Roland Speicher and his group, giving two informal lectures to the group.

Participated in *Recent advances in Operator Theory and Operator Algebras* held at Indian Statistical Institute, Bangalore during Dec 31, 2012 – Jan 11, 2013.

Visited Indian Institute of Science during Mar 17 – Mar 30, 2013. Discussions with Prof. Manjunath Krishnapur, giving a talk in Bangalore Probability Seminar 2013.

**Bhattacharya, Soumyadeep**

Participated in *RRI School on Statistical Physics* held at Raman Research Institute, Bengaluru during Mar 26 – Apr 7, 2012.

Participated in *Complexity and Diversity: Realm of Today's Statistical Physics* held at Saha Institute of Nuclear Physics, Kolkata during Jan 14 – Jan 17, 2013.

Participated in *Defects and Heterogeneities in Fracture & Flow* held at The Institute of Mathematical Sciences, Chennai during Jan 21 – Jan 24, 2013.

**Chakraborty, Partha S.**

Participated in *Workshop on Lie Groupoids and Lie Algebroids* held at Indian Statistical Institute, Kolkata during Dec 10 – Dec 21, 2012. Invited speaker

**Chatterjee, Pralay**

Participated in *Groups, Geometry and Dynamics* held at CEMS, Kumaun University, Almora, Uttarakhand during Dec 3 – Dec 16, 2012. Gave four lectures on Lattices in Lie groups

Participated in *Recent trends in Ergodic Theory and Dynamical Systems* held at Department of Mathematics, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara during Dec 18 – Dec 29, 2012. Invited speaker. Gave a lecture on "On the second cohomology of nilpotent orbits".

Participated in *Lecture series on the topology of locally symmetric spaces* held at Tata Institute of Fundamental Research, Centre For Applicable Mathematics, Bangalore during Feb 4 – Feb 14, 2013. Gave two lectures on Lattices in Lie groups

**Chatterjee, Tapas**

Participated in *Panorama Lectures* held at Kerala School Of Mathematics during May 1 – May 4, 2012.

Participated in *workshop on the theory of numbers and related areas* held at Kerala School Of Mathematics during May 6 – May 10, 2012.

Participated in *AIS in Circle method* held at IMSc, Chennai during Jun 25 – Jul 14, 2012. Delivered a series of lectures on the "Gamma functions and Functional Equations of Riemann zeta and Hurwitz zeta functions"

Participated in *AFS-I* held at CMI, Chennai during Dec 25 – Dec 29, 2012. Tutor of the Modules over PID course

**Date, G.**

Visited IUCAA, Pune during Sep 16 – Oct 17, 2012. Academic interaction and completing research work.

Visited HBNI, BARC on Nov 21, 2012. HBNI Dean's meeting.

Participated in *27th IAGRG Meeting* held at Dept of Physics, HNB Garhwal University, Srinagar during Mar 7 – Mar 9, 2013. Gave Popular lecture on *Global Positioning and Relativity*

Participated in *Workshop on Physics and Mathematics of the Universe* held at Gurukula Kangri Vishwavidyalaya, Haridwar during Mar 11 – Mar 12, 2013. Gave the keynote lecture on *Our Universe: What We Know and How.*

**Dutta, Soma**

Visited Madras University on Dec 7, 2012. Delivered a lecture on Fuzzy logic and Artificial Intelligence in the UGC sponsored Teachers' Orientation course.

Participated in *TARK 2013* held at Institute of Mathematical Sciences, Chennai during Jan 7 – Jan 9, 2013.

Participated in *ICLA2013* held at Institute of Mathematical Sciences, Chennai during Jan 10 – Jan 12, 2013. Presented a paper entitled 'Many-valued logics, fuzzy logics and graded consequence: a comparative appraisal'

Participated in *2nd International conference on rough sets, fuzzy sets and soft computing* held at Tripura University during Jan 17 – Jan 19, 2013. Presented a paper on 'Algebra of negation fragment of a logic with graded notion of consequence'

**Geetha, T.**

Participated in *Connection for women:Joint workshop for Commutative algebra and Cluster* *algebras* held at Mathematical Sciences Research Institute(MSRI), Berkeley, USA during Aug 22 – Aug 24, 2012.

Participated in *Joint Introductory Workshop: Cluster Algebras and Commutative algebra* held at Mathematical Sciences Research Institute(MSRI), Berkeley,USA during Aug 27 – Sep 7, 2012.

Visited University of Iowa, Iowa, USA during Sep 8 – Sep 23, 2012. Visited Prof. Fred Goodman for collaborative work. Presented a talk on Cellular algebras and wreath products

Participated in *Grading and Decomposition numbers* held at University of Stuttgart, Germany during Sep 24 – Sep 28, 2012. Presented a contributed talk titled Cellularity of wreath product algebras

Participated in *Mathematics Workshop for Higher Secondary / Senior Secondary School Students* held at IMSc on Oct 31, 2012. Presented an invited talk on Integer partitions

Participated in *125th birthday celebrations of Ramanujan* held at Deivanai Ammal College for women, Villupuram on Dec 12, 2012. Presented an invited talk on Integer partitions

Participated in *Magnum opus* held at Nandha Arts and Science college, Erode during Feb 4 – Feb 5, 2013. Presented an invited talk on Representation theory of symmetric groups and its Applications

**Ghosh, Sibasish**

Visited Indian Statistical Institute, Kolkata during May 20 – May 28, 2012. Gave a talk there at the Physics and Applied Mathematics Unit (PAMU) of Indian Statistical Institute, Kolkata and had discussions with the members of the group of Prof. Guruprasad Kar of PAMU, which initiated the work [**G1**].

Visited University of KwaZulu-Natal, Durban, South Africa during Jul 16 – Aug 4, 2012. Visited the group of Prof. Thomas Konrad at the School of Chemistry and Physics, Univ. of KwaZulu-Natal. Gave a talk there and discussed with the group members of Prof. Konrad.

Visited Indian Statistical Institute, Delhi during Jan 23 – Jan 27, 2013. Visited Prof. Ajit Iqbal Singh at ISI, Delhi, gave an informal talk and continued collaborating on an ongoing research project.

Visited Indian Institute of Technology, Rajasthan during Jan 28 – Feb 2, 2013. Visited the physics department of IIT-Rajasthan, gave a seminar, and continued an ongoing collaborative work with Dr. Subhashish Banerjee of IIT-Rajasthan.

Visited Indian Statistical Institute, Kolkata during Feb 12 – Mar 8, 2013. Visited the Physics and Applied Mathematics Unit (PAMU) of ISI-Kolkata, gave a seminar and collaborated with the group members of Prof. Guruprasad Kar of PAMU.

Participated in *One Day National Seminar on Quantum Computers* held at VIT University, Chennai on Feb 23, 2013. Gave an invited talk on quantum entanglement and quantum correlations

**Gun, S.**

Participated in *Panorama Lectures* held at Kerala School of Mathematics during Apr 30 – May 9, 2012.

Participated in *AIS on Circle method* held at IMSc during Jun 25 – Jul 14, 2012. Gave a series of four one and half hour lectures.

Participated in *Indo-French symposium* held at IISER, Pune during Sep 3 – Sep 7, 2012. Invited Speaker

Participated in *National seminar IRCMS-2012* held at Bose Institute, Kolkata during Nov 23 – Nov 24, 2012. Invited Speaker

Participated in *The Legacy of Ramanujan* held at Delhi University, Delhi during Dec 17 – Dec 22, 2012. Invited Speaker

**Gupta, Saurabh**

Participated in *International Conference on "New Trends in Field Theories-3"* held at Banaras Hindu University, Varanasi during Nov 23 – Nov 26, 2012. Delivered a talk on "Superfield Approach to Massive 3D Jackiw-Pi Model".

Participated in *IMSc Golden Jubilee Symposium on "Frontiers of High Energy Physics"* held at The Institute of Mathematical Sciences, Chennai during Dec 10 – Dec 13, 2012.

Visited Banaras Hindu University, Varanasi for collaborative work during Feb 18 – Feb 23, 2013.

**Inbasekar, Karthik**

Participated in *International School on Strings and Fundamental Physics.* held at Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany during Jul 1 – Jul 13, 2012. Presented a talk on "Generalized Attractors in Five-Dimensional Gauged Supergravity"

Participated in *Indian Strings Meeting* held at Puri, Orissa, India. during Dec 16 – Dec 21, 2012. Invited talk on "Generalized Attractors in Five-Dimensional Gauged Supergravity"

**Kesavan, S.**

Participated in *Shape optimization problems and spectral theory* held at CIRM, Luminy, Marseilles, France during May 28 – Jun 1, 2012. Participated in the conference

Participated in *Summer programme for MSc students* held at Ramanujan Institute for Advanced Study in Mathematics, University of Madras during Jun 7 – Jun 13, 2012. Delivered a series of six lectures on Measure and Integration

Participated in *Workshop for teachers: IMSC@50* held at IMSc during Aug 10 – Aug 11, 2012. Delivered two lectures on calculus.

Participated in *Almora Mathematical Surveys* held at Kasar Jungle Resort, Almora during Oct 3 – Oct 6, 2012. Delivered an invited talk

Participated in *Workshop for College Teachers: IMSc@50* held at IMSc during Nov 29 – Nov 30, 2012. Gave a talk on differential equations

Participated in *Advanced Foundational School* held at Chennai mathematical Institute on Dec 20, 2012. Gave an invited talk under the 'Unity in Mathematics' banner.

Visited Anna University on Dec 22, 2012. Delivered the Ramanujan Endowment Lecture

Visited Cochin University of Science and Technology on Jan 10, 2013. Delivered a colloquium talk.

Participated in *National seminar on Mathematical Analysis and its Applications in New Perspective* held at PMG College, Chalakudy, Kerala during Jan 10 – Jan 11, 2013. Was the chief guest at the inauguration and delivered an invited talk.

Visited Chennai Mathematical Institute on Feb 20, 2013. Delivered the Rubgunday Memorial Endowment Lecture.

Visited International Mathematical Union, Berlin during Mar 9 – Mar 11, 2013. To attend a joint meeting of the Commission for Developing Countries and the Executive Committee of the International Mathematical Union

**Kodiyalam, Vijay**

Participated in *Almora Mathematical Surveys* held at Centre for Excellence in Mathematical Sciences, Kumaon University, Almora during Oct 3 – Oct 6, 2012. Gave a talk on "Algebraic invariants of subfactors"

**Krishna, M.**

Participated in *3rd Indo Brazil Symposium on Mathematics* held at Institute of Pure and Applied Mathematics (IMPA), Rio De Janeiro, Brazil during Aug 13 – Aug 17, 2012. Talk given on "Szego limit theorem on the lattice"

Participated in *Ramanujan Mathematical Sociery Annual Conference -Analysis symposium* held at Radison Hotel Blue, New Delhi during Oct 22 – Oct 23, 2012. Gave a talk on “Szego limit theorems on the lattice”

Participated in *Ramanujan Symposium on “Mathematical Analysis and Applications”* held at Ramanujan Institute, Chennai during Oct 29 – Oct 31, 2012. Gave a talk on “Random Operators”

Participated in *Ramanujan Symposium on “Mathematical Analysis and Applications”* held at Ramanujan Institute, Chennai during Oct 29 – Oct 31, 2012. Gave a talk on “Random Operators”

Participated in *Spectra of Random Operators and Related Topics* held at Department of Mathematics, Kyoto Univeristy, Kyoto, Japan during Dec 5 – Dec 7, 2012. Gave a talk on “Level repulsion for decaying randomness”

Participated in *Spectra of Random Operators and Related Topics* held at Department of Mathematics, Kyoto Univeristy, Kyoto, Japan during Dec 5 – Dec 7, 2012. Gave a talk on “Level repulsion for decaying randomness”

Participated in *Limit theorems in probability* held at Department of Mathematics, Indian Institute of Science, Bangaluru during Jan 10 – Jan 11, 2013. Gave a talk on “Level repulsion for random decaying interactions”

Visited Department of Mathematics, Indian Institute of Science, Bangaluru on Feb 12, 2013. Gave a talk “About the density of states in Random Operators”

**Lodaya, Kamal**

Visited TIFR, Mumbai during May 18 – Jun 19, 2012. Gave two talks on “Probabilistic automata and their verification”.

Visited IIT Bombay on Jun 11, 2012. Gave a talk on “Locality and free choice”.

Visited IIT Guwahati during Nov 1 – Nov 2, 2012. Gave a talk on “Probabilistic systems and their verification”.

Visited Tezpur University on Nov 2, 2012. Gave a talk on “Alan Turing and the origin of computer science”.

Visited Anna University on Nov 16, 2012. Gave a talk on “Automata, concurrency and communication” at the Alan Turing centenary year workshop.

Visited University of Madras, Chennai during Nov 21 – Nov 22, 2012. Gave two lectures on “Turing machines and Petri nets” at the UGC course for computer science teachers.

Visited University of Madras, Chennai on Dec 7, 2012. Gave a talk on "Using formal logic in programming" in the UGC course for computer science teachers.

Participated in *32nd FSTTCS* held at IIIT Hyderabad during Dec 15 – Dec 18, 2012. Also attended the workshop on "Verification of infinite-state systems" on 18 December 2012.

**Mahajan, Meena B.**

Visited Université Paris Diderot - Paris 7, France. during May 17 – Jun 16, 2012. This visit was for research collaboration under an ongoing IFCPAR project

Visited Max-Planck Institute for Informatics, Saarbrucken, Germany during Jul 10 – Jul 31, 2012. This visit was for research collaboration under an ongoing IMPECS project

Participated in *Mysore Park Workshop: Recent Trends in Algorithms and Complexity* held at Infosys Campus, Mysore during Aug 10 – Aug 12, 2012.

Participated in *Workshop on Complexity and Logic* held at IIT Kanpur during Aug 17 – Aug 19, 2012. Gave a talk titled "Enumerating languages by verifying proofs".

Participated in *Dagstuhl Seminar on Algebraic and Combinatorial Methods in Computational Complexity* held at Schloss Dagstuhl during Oct 15 – Oct 19, 2012. Gave a talk titled "$NC^0$ proof systems".

Participated in *Alan Turing Centenary Year: Workshop on Advanced Topics in Theoretical Computer Science* held at Anna University, Chennai. during Nov 16 – Nov 18, 2012. Gave a talk titled "Matchings in Graphs: What, Why, How ...".

Participated in *Workshop on Art of Computing, Alan Turing Centenary Year Celebrations* held at PSG College of Technology, Coimbatore during Dec 7 – Dec 8, 2012. Gave a talk titled "The Power of Negations in Boolean Circuits".

Participated in *Dagstuhl seminar on Computational Counting* held at Leibniz Center for Informatics, Schloss Dagstuhl, Germany during Jan 14 – Jan 18, 2013. Gave a talk titled "Enumerating Monomials"

Participated in *Workshop on Algebraic Complexity Theory* held at CTIC Arhus, Denmark during Mar 18 – Mar 22, 2013. Gave a talk titled "Multilinear Formulas to Register Programs: Why and How?"

**Mandayam, Prabha**

Participated in *Summer School on Quantum Computation* held at Indian Institute of Science, Bangalore during May 21 – May 26, 2012. Lecturer at the Summer School

Participated in *International conference on Quantum Information and Quantum Computing* held at Indian Institute of Science, Bangalore, India during Jan 7 – Jan 11, 2013. Gave an invited Talk

**Menon, Shakti N.**

Participated in *School on Networks in Biology, Social Science and Engineering* held at Indian Institute of Science, Bangalore during Jul 2 – Jul 11, 2012.

Participated in *International Conference on Networks in Biology, Social Science and Engineering* held at Indian Institute of Science, Bangalore during Jul 12 – Jul 14, 2012. Presented a poster entitled "Modelling the fibroblast-keratinocyte crosstalk during wound healing".

Participated in *INCF Workshop on "Neuroinformatics of sensory-motor integration: modeling and imaging from the worm to the human nervous system"* held at IMSc and IIT-Madras during Nov 5 – Nov 7, 2012.

**Mitra, Tanmay**

Participated in *Bayes by the Bay - A Pedagogical Workshop on Bayesian Methods in Science* held at The Hotel Atithi, Pondicherry. during Jan 4 – Jan 8, 2013.

**Mukhopadhyay, Partha**

Participated in *International Conference on Mathematical Modeling in Physical Sciences, 2012* held at Budapest, Hungary during Sep 3 – Sep 7, 2012. Presented contributory talk: "Towards a loop space description of non-linear sigma model"

Visited Physics Department North Bengal University during Sep 19 – Oct 1, 2012. Taught General Theory of Relativity in preparatory SERC School in Theoretical High Energy Physics.

**Murthy, M.V.N.**

Visited Department of Physics and Astronomy, Mcmaster University, Hamilton, Canada during Apr 8 – May 1, 2012. Research collaboration with Prof. R K Bhaduri

Participated in *Pathways to Higgs Boson: Model, Experiments and Beyond (supported by the Academies)* held at American College, Madurai during Aug 28 – Aug 29, 2012. Lecture on "Big world of small neutrinos"

Participated in *Lectures on Theoretical Physics organised in memory of Prof. K N Srinivasa Rao, supported by the Academies.* held at Department of Physics, University of Mysore, Mysore during Nov 8 – Nov 10, 2012. Lecture on "Three is company: The Efimov effect"

**Nagaraj, D. S.**

Participated in *International conference on Vector Bundles. (In Honor of Prof. Mohan Kumar)* held at KSOM, Calicut, Kerala. during Apr 1 – Apr 7, 2012. Gave a invited talk "Vector bundles generated by sections on projective spaces" at the international conference on "Vector bundles" in honor of Prof. Mohan Kumar, held at

Visited University D'Artois, Lens, France during Sep 1 – Sep 30, 2012. Gave a talk titled "Algebraic surfaces and Kodaira dimensions".

Visited Kuvempu University, Shimoga, Karnataka during Oct 5 – Oct 6, 2012. Gave two talks on "Group actions and its applications" on 5th Oct 2012 in the "three days Special Lecture Series in Mathematics"

Visited University of Mysore during Feb 4 – Feb 6, 2013. Gave lectures and conducted tutorials as part of the IMSc Mysore university-workshop Conducted by Prof. K.N. Ragahavan.

Visited Central University of Tamil Nadu, Thiruvauar. during Mar 5 – Mar 6, 2013. Gave Three lectures on Algebra. Gave a colloquium titled "An Introduction to Algebraic Geometry"

**Paul, Pampa**

Participated in *Workshop on "Representation of real Lia groups"* held at Tata Institute of Fundamental Research, Mumbai. during Feb 11 – Feb 15, 2013.

**Prasad, Amritanshu**

Visited Ramanujan Institute for Advanced Studies in Mathematics (University of Madras) during Mar 14 – Mar 19, 2013. Taught a course on Combinatorics of Permutations.

**Raghavan, K. N.**

Participated in *Fourth Summer Training Program* held at Ramanujan Institute for Advanced Study in Mathematics, Chennai during May 24 – May 30, 2012. As a resource person, conducted lectures and tutorials on linear algebra during six morning sessions of the program.

Participated in *Advanced Foundational School III* held at Harish-Chandra Research Institute, Allahabad during Jul 5 – Jul 13, 2012. As a resource person, gave six lectures on algebra (field theory) at the school.

Participated in *The 5th MSJ-SI Mathematical Society of Japan Seasonal Institute: Schubert Calculus* held at Osaka City University, Osaka, Japan during Jul 15 – Jul 27, 2012. As an invited speaker at the conference, delivered a talk on "RSK correspondence and KL Cells".

Participated in *Lecture Program for School Teachers* held at IMSc on Aug 11, 2012. Gave a lecture on “co-ordinate geometry”.

Participated in *Refresher Course in Topology for Mathematics Teachers* held at Ramanujan Institute for Advanced Studies in Mathematics during Oct 6 – Oct 8, 2012. As a resource person, lectured on quotient topology, product topology, and Tychonoff’s theorem.

Visited Central University, Hyderabad on Nov 27, 2012. Purpose: evaluation of mathematics doctoral student.

Participated in *Mathematics Lecture Program for College/University Teachers* held at IMSc on Nov 29, 2012. Gave a lecture on algebra.

Participated in *Advanced Instructional School on Aspects of Galois Theory* held at Harish-Chandra Research Institute, Allahabad during Dec 11 – Dec 15, 2012. As a resource person, gave five lectures on “separable algebras”.

Participated in *Workshop on Syzygies and Free Resolutions* held at Chennai Mathematical Institute during Dec 17 – Dec 22, 2012.

Participated in *Panorama Lecture Series on Free Resolutions by David Eisenbud* held at Chennai Mathematical Institute, Chennai during Dec 24 – Dec 28, 2012.

Visited Indian Academy of Sciences, Bengaluru on Jan 18, 2013. Member of Selection Committee to recommend candidates for Summer Research Fellowship 2013.

Participated in *Workshop in preparation for Panorama Lecture Series by Toshi Kobayashi* held at Tata Institute of Fundamental Research, Mumbai during Feb 10 – Feb 14, 2013. Delivered three lectures on “Branching laws for classical groups”.

Participated in *Panorama Lecture Series by Toshi Kobayashi* held at Tata Institute of Fundamental Research, Mumbai during Feb 17 – Feb 22, 2013.

**Rai, Ashutosh**

Participated in *Scandinavian Symposium and Workshops on Algorithm Theory (SWAT) 2012* held at University of Helsinki, Helsinki, Finland during Jul 4 – Jul 6, 2012. Presented paper titled “Faster Parameterized Algorithms for Deletion to Split Graphs”.

Participated in *3rd Annual Mysore Park Workshop* held at Mysore Infosys campus, Mysore, India during Aug 10 – Aug 12, 2012.

Participated in *Foundations of Software Technology and Theoretical Computer Science (FSTTCS) 2012* held at IIT Hyderabad, Hyderabad, India during Dec 15 – Dec 17, 2012.

**Rajasekaran, G.**

Visited University of Madras during Apr 1, 2012 – Mar 31, 2013. Gave two courses of lectures to students 1.Quantum Mechanics, 2. Particle Physics, during Sundays.

Participated in *Collaboration Meeting on DINO (Darkmatter at INO)* held at IIT, Mumbai during Apr 26 – Apr 27, 2012.

Participated in *Summer Training Program In Physics* held at Department of Nuclear Physics, University of Madras during Jun 5 – Jun 15, 2012. Gave two lectures: 1. A journey through microcosmos, 2. The elusive neutrinos and INO

Participated in *Meeting of the Joint Science Education Panel of the Academy* held at Indian Academy of Sciences, Bangalore on Jul 12, 2012.

Participated in *Academy Symposium on "Bridging the gap between Earth and Life sciences"* held at Indian Institute of Science, Bangalore on Jul 12, 2012.

Visited Centre for High Energy Physics,Indian Institute of Science, Bangaluru on Jul 12, 2012. Gave a seminar on "Unification of lepton and quark mixing through renormalization group evolution"

Participated in *Mid-Year Meeting of the Indian Academy of Sciences* held at Indian Institute of Science, Bangalore during Jul 13 – Jul 14, 2012.

Visited Indian Institute for Astrophysics,Bangaluru on Aug 6, 2012. Gave a Colloquium "Standard Model and Higgs"

Participated in *INO Collaboration Meeting* held at Theni (near Neutrino Nagar) during Aug 9 – Aug 11, 2012.

Participated in *Reecent developments in Theoretical Physics* held at University of Madras during Aug 10 – Aug 11, 2012. Gave an invited talk on "Standard Model and Higgs"

Participated in *"Top-Higgs"* held at Centre for High Energy Physics, Indian Institute of Science, Bangaluru during Aug 24 – Aug 26, 2012.

Participated in *Academy Workshop on "Higgs and Neutrinos"* held at The American College, Madurai during Aug 28 – Aug 29, 2012. Gave two talks: 1. Introduction to the Standard Model and the discovery of the Higgs boson, 2. Tamil version with same content

Visited Madurai Kamaraj University on Aug 29, 2012. Gave two talks: 1. Standard Model, Higgs Boson and What Next?, 2. Neutrinos and INO

Participated in *National Conference on "The Contributions of Madras Christian College in the Making of Modern India: a Historical Perspective"* held at Madras Christian College, Tambaram on Oct 26, 2012.

Participated in *Refresher Course in Physics* held at Madurai Kamaraj University during Nov 16 – Nov 17, 2012. Gave two lectures on “Basic Principles of Quantum Mechanics” and one lecture on “Neutrinos and INO”.

Participated in *Conference on “Quantum Field Theory”* held at Banares Hindu University during Nov 23 – Nov 26, 2012. Gave a talk on “Standard Model, Higgs Boson and What Next?”

Visited Madras Christian College, Tambaram on Dec 6, 2012. Gave a talk on “Standard Model,Higgs Boson and What Next?”

Participated in *One-day seminar on “Higgs and Neutrinos”* held at Department of Nuclear Physics, University of Madras on Dec 7, 2012. Gave two lectures:1. Standard Model,Higgs Boson and What Next?, 2.The Elusive Neutrinos and INO

Participated in *Conference on “Frontiers in High Energy Physics”* held at IMSc,Chennai during Dec 10 – Dec 13, 2012.

Participated in *IMSc Golden Jubilee Meeting* held at IMSc during Jan 2 – Jan 4, 2013. Gave a talk on “A partial history of IMSc: Ups and Downs”

Participated in *Centenary Meeting of the Indian Science Congress* held at Kolkata on Jan 5, 2013. Gave an Invited Talk on “Manpower for Fundamental Physics Experiments” in the Homi Bhabha Session on Mega Science and India.

Participated in *Workshop on “Recent Developments in Physics”* held at Sri GVG Visalakshi College for Women,Udumalpet during Feb 6 – Feb 7, 2013. Gave a talk on “Understanding the ultimate structure of matter”.

Participated in *Conference on “Advances in Quantum Theory”* held at University of Hyderabad during Feb 25 – Feb 26, 2013. Gave a talk on “Standard Model and Higgs Boson”

Participated in *INO Collaboration Meeting* held at BARC, Mumbai during Mar 5 – Mar 7, 2013.

Participated in *Conference on “Current state of HEP”* held at IISER, Kolkata during Mar 15 – Mar 16, 2013. 1.Talked on “A stable massive charged particle”.2. Gave a Colloquium on “Standard Model, Higgs Boson and What Next?”

**Raman, Venkatesh**

Visited Vienna University of Technology, Vienna, Austria during Jun 4 – Jun 10, 2012. Collaborated with Stefan Szeider

Participated in *Data Reduction and Problem Kernels* held at Dagstuhl, Germany during Jun 10 – Jun 15, 2012.

Participated in *15th International Conference on Theory and Applications of Satisfiability Testing* held at Trento,Italy during Jun 17 – Jun 20, 2012. Delivered a talk on 'Parameterized Complexity of Satisfying Beyond the Number of Variables'

Participated in *3rd Annual Mysore Park Theory Workshop* held at Infosys Campus, Mysore during Aug 10 – Aug 12, 2012.

Visited PSG College of Technology, Coimbatore on Feb 9, 2013. Organized a workshop on Research methodology

Participated in *Seventh International Workshop on Algorithms and Computation* held at IIT Kharagpur during Feb 15 – Feb 16, 2013. Gave a talk on 'Improved Fixed-parameter tractable algorithm for minimum weight 3SAT'

**Ramanujam, R.**

Visited Isaac Newton Institute of Mathematical Sciences, Cambridge University during May 20 – Jun 13, 2012. Participated in the Turing Centenary programme and gave a talk on "Bounds on proof size and security verification".

Visited University of Nottingham on May 30, 2012. Gave a lecture on "Games and epistemic logic".

Visited University of Liverpool, UK. on May 31, 2012. Gave a seminar on "Dynamics in large games".

Visited Imperial College, London, UK. on Jun 5, 2012. Gave a seminar on "Complexity of security verification".

Participated in *Game theory and epistemic logic* held at Tsukuba University, Japan during Aug 27 – Aug 31, 2012. Gave a talk on "Player types in large games"

Participated in *Turing and Logic: conference of the Calcutta Logic Circle* held at IBRAD, Kolkata during Sep 27 – Sep 30, 2012. Gave a talk on "Turing's thesis".

Participated in *Annual conference of the Ramanujan Math Society* held at Shiv Nadar University, New Delhi. during Oct 20 – Oct 23, 2012. Gave a talk on Szemeredi's theorem and applications.

Participated in *Descriptive set theory and model theory* held at ISI, Kolkata during Dec 27, 2012 – Jan 2, 2013.

Participated in *Instructional School on Logic and Set theory* held at Kerala School of Mathematics, Kozhikode. during Feb 25 – Mar 8, 2013. Gave 7 lectures on first order logic.

**Ray, Purusattam**

Visited SINTEF Petroleum Research and Norwegian University of Science and Technology, Trondheim, Norway during Sep 12 – Sep 25, 2012. Scientific collaboration.

Visited Norwegian University of Science and Technology, Trondheim, Norway during Sep 25 – Sep 29, 2012. Gave a colloquium on 'Shock propagation in granular system'

Participated in *Advances in Computational Physics* held at Central University of Tamil Nadu, Thiruvarur during Feb 14 – Feb 18, 2013. Invited Speaker

Visited Saha Institute of Nuclear Physics, Kolkata during Feb 18 – Feb 22, 2013. Scientific research collaboration.

**Sankaran, Parameswaran**

Participated in *Geometry and arithmetic of lattices* held at Durham University, Durham, UK during Jun 27, 2011 – Jul 9, 2012. Invited participant

Participated in *Workshop in topology* held at Indian Statistical Institute, Kolkata during May 16 – May 17, 2012. Gave two lectures on 'Formal group laws and complex cobordism'

Participated in *Summer training programme for MSc students* held at Ramanujan Institute, Chennai during May 27 – May 29, 2012. Gave six lectures in group theory

Participated in *Brazilian Topology Meeting* held at Organized by The University of Sao Carlos, Agua di Lindoia, SP, Brazil during Jul 29 – Aug 3, 2012. Gave a mini-course on geometric group theory

Visited University of Sao Paulo, Sao Paulo, Brazil during Aug 3 – Aug 7, 2012.

Visited Vivekananda College, Mylapore, Chennai on Sep 7, 2012. Inaugurated the Mathematics Association and gave a talk on the 'Ramanujan's tau-function.'

Participated in *Refresher course in Mathematics* held at Ramanujan Institute, Chennai during Oct 16 – Oct 17, 2012. Gave four lectures on covering spaces.

Participated in *Lie algebroid and Lie groupiod* held at ISI, Kolkata, during Dec 17 – Dec 21, 2012. Gave an invited talk on 'rational homotopy of certain CW complexes'

Participated in *National Seminar on Mathematics* held at NGM College, Pollachi on Jan 8, 2013. Gave a talk on non-Euclidean geometry.

Participated in *Workshop on representation theory* held at TIFR, Mumbai. during Feb 11 – Feb 15, 2013. Gave six lectures on admissible representations.

Participated in *Panorama lectures in representation theory by Toshiyuki Kobayashi* held at TIFR Mumbai during Feb 18 – Feb 22, 2013.

**Sathiapalan, Balachandran**

Visited CHEP, IISc Bangalore during Sep 19 – Sep 21, 2012. Physics Colloquiu on "Holographic BCS Superconductivity" and informal seminar on "Loop Variables"

Participated in *Light Cone Physics-2012* held at Delhi University during Dec 14 – Dec 15, 2012. Invited talk on "Loop Variables and Gauge Invariant Exact Renormalization Group in String Theory"

**Sinha, Nita**

Participated in *The XXV International conference on Neutrino Physics and Astrophysics (Neutrino2012)* held at Kyoto, Japan during Jun 3 – Jun 9, 2012.

Participated in *INO Collaboration meeting* held at Theni International, Theni, TamilNadu during Aug 10 – Aug 11, 2012. Presented the Physics and Simulations summary.

Participated in *XX DAE-BRNS HEP symposium 2013* held at Visva-Bharati, Shantiniketan during Jan 13 – Jan 18, 2013. Chaired the concluding session.

Participated in *ICTS-TIFR Program on CP Violation in Elementary Particles and Composite Systems (PCPV2013)* held at Fountain Hotel, Mahabaleswar during Feb 7 – Feb 23, 2013. Participated in the workshop and invited to Chair a session.

Participated in *ICTS-TIFR Program on CP Violation in Elementary Particles and Composite Systems (PCPV2013)* held at Fountain Hotel, Mahabaleswar during Feb 7 – Feb 23, 2013. Invited to Lecture in the school.

Participated in *National Conference on Contemporary Issues in HEP and Cosmology (NC-HEPC2013)* held at Gauhati University during Feb 12 – Feb 14, 2013. Delivered an invited plenary talk on "CP Violation and Flavour".

**Sinha, Sitabhra**

Visited Department of Computer Science, IIT Kharagpur during Apr 2 – Apr 4, 2012. Taught a module in course on complex networks

Visited Jawaharlal Nehru Center for Advanced Scientific Research, Bangalore on Apr 24,

2012. Viva voce external examiner for PhD thesis

Participated in *Workshop on Systems Science of Complex Networks* held at Indian Institute of Technology, Jodhpur during May 7 – May 9, 2012. Invited talk on "Understanding the emergent complexity of networks: from the cell to society"

Participated in *School on Networks in Biology, Social Science and Engineering* held at Indian Institute of Science, Bangalore during Jul 2 – Jul 11, 2012. Three lectures on "Ecological Networks"

Participated in *Calcutta Logic Circle Annual Meeting on Logic and its Applications* held at Indian Institute of Bio-Social Research and Development (IBRAD), Kolkata on Oct 1, 2012. Invited talk on "Turing and the science of life"

Participated in *Workshop on Mathematical Finance* held at Indian Institute of Technology, Guwahati during Oct 31 – Nov 1, 2012. Three invited lectures on "Analyzing socio-economic phenomena using physics"

Participated in *Indo-French Center for Applied Mathematics Meeting* held at Universite de Nice Sophia Antipolis, Nice, France during Nov 19 – Nov 21, 2012. Invited talk on "Patterns of life and death: Complex spatio-temporal dynamics in heterogeneous biological systems"

Visited Ecole Normale Superieure, Lyon during Nov 22 – Dec 4, 2012. Member of panel of examiners for PhD thesis viva voce

Participated in *Conference on Diversity & Complexity: Realm of todays statistical physics* held at Saha Institute of Nuclear Physics, Kolkata during Jan 14 – Jan 17, 2013. Invited talk on "Why so few are hot, so many are not: Explaining the bimodal distribution of popularity"

Participated in *Workshop on Nonlinear Waves: Theory and Simulation* held at National Institute of Technology, Durgapur, West Bengal on Jan 17, 2013. Invited talks on "Pattern formation and wave propagation in nonlinear media" and "Patterns of life and death: Complex spatio-temporal dynamics in nonlinear biological systems"

Participated in *Workshop on Complex and Social Networks* held at Heritage Institute of Technology, Kolkata during Jan 24 – Jan 25, 2013. Invited talk on "Mapping the evolution of science through network analysis:The rise of inter-disciplinarity inphysics 1985-2009"

Visited Saha Institute of Nuclear Physics, Kolkata during Feb 5 – Feb 6, 2013. Institute colloquium lecture on "Mapping the changing world of physics 1985-2009"

Participated in *National Consultation Meeting on Application of Infectious disease modelling in public health challenges and opportunities for India* held at National Centre for Disease Control, New Delhi on Feb 7, 2013. Invited talk on "Infectious disease modeling in India: Data expectations versus reality"

Participated in *Research meeting on strategic network formation and evolution* held at Indian Statistical Institute, Kolkata during Mar 7 – Mar 8, 2013. Invited talk on "Networks, modules and games: Dynamics of social networks with community organization"

Participated in *National Seminar on Nonlinearity, Complex Dynamics & Chaos in Economics and Finance* held at Calcutta University during Mar 13 – Mar 14, 2013. Invited talk on "Using physics to explain society: The new science of econophysics"

**Srilakshmi, K.**

Participated in *Workshop on Bloch-Kato Conjectures for the Riemann zeta function* held at IISER, Pune during Jul 17 – Jul 21, 2012.

Participated in *The Pan Asian Number Theory Conference* held at IISER, Pune during Jul 23 – Jul 27, 2012.

Participated in *Mathematics workshop for school students* held at IMSc on Oct 31, 2012. Gave an invited talk on "Some solved and unsolved problems in mathematics"

Participated in *Mathematics workshop for school teachers* held at IMSc on Nov 17, 2012. Gave an invited talk on "Mathematical Puzzles"

Participated in *Mathematics Panorama Lectures "Some connections between representation theory and number theory" by Professor B. Gross* held at TIFR, Mumbai during Jan 7 – Jan 11, 2013.

Participated in *Advanced Training in Mathematics Workshop on Hilbert Modular forms and varieties* held at Kerala School of Mathematics, Kozhikode during Jan 21 – Jan 31, 2013. Gave an invited talk on "The Doi-Naganuma Lifting".

**Srinivas, K.**

Participated in *National workshop on Cryptography* held at VIT, Vellore during Aug 6 – Aug 7, 2012. Attended the workshop, chaired a session.

Participated in *National Conference on Algebra and Number theory* held at Department of Mathematics, University of Cochin, Cochin during Aug 16 – Aug 18, 2012. Delivered an invited talk on the zeros of zeta-functions

Participated in *Annual Conference of the RMS* held at S. N. University, Delhi during Oct 19 – Oct 23, 2012. Participated in the talks, EC and GB meeting of RMS.

Participated in *International Conference on the Works of Srinivasa Ramanujan and Related Topics* held at Department of Mathematics, University of Mysore, Mysore during Dec 12 – Dec 14, 2012. Delivered a talk on a Lattice point problem considered by Ramanujan.

Participated in *National Mathematics Day* held at Town High School, Kumbakonam on Dec 22, 2012. Delivered a talk on *Influence of Ramanujan and other mathematicians*.

**Sunder, V. S.**

Participated in *2012 LMS Midlands Regional Meeting Workshop "Quantum Probabilistic Symmetries"* held at Aberystwyth University, Wales during Sep 3 – Sep 7, 2012. Gave an invited talk on'Hilbert von-Neumann modules'

Participated in *Workshop on operator algebras and non-equilibrium statistical mechanics* held at Bambolim, Goa during Dec 17 – Dec 21, 2012. Gave the first half of an invited two-part talk - along with my student Panchugope Bikarm - on 'Extendability of endomorphisms of factors'. Also chaired a session in the conference.

Participated in *Recent advances in Operator Theory and Operator Algebras* held at ISI, Bngalore during Jan 7 – Jan 11, 2013. Was supposed to give a talk on joint work with my student Madhushree Basu on our joint work on 'Continuous Minimax Theorems', but as she was also at the conference, I got her to give the talk instead. Also chaired a session in the conference.

**Mubeena, T.**

Participated in *Mathematical Panorama Lectures on Recent Developments in 3-manifold theory* held at IISc, Bangalore during Jun 25 – Jun 29, 2012.

Participated in *ATMW Almora Mathematical Surveys 2012* held at Kumaun University, Almora (Uttarakhand) during Oct 3 – Oct 6, 2012. A survey about important developments in several areas of mathematics.

**Vaish, Vaibhav**

Visited HBCSE, Mumbai during Oct 20 – Oct 23, 2012. Regional and National Mathematics Olympiad problem generation camp

Participated in *ATM Workshop on Singularity Categories in Algebraic Geometry and Commutative Algebra* held at IIT Chennai during Jan 2 – Jan 12, 2013.

Participated in *Representation Theory of Real Lie Groups* held at TIFR Mumbai during Feb 11 – Feb 16, 2013.

Participated in *Branching laws for infinite dimensional representations of real Lie groups* held at TIFR Mumbai during Feb 18 – Feb 22, 2013.

Visited IISER Mohali during Feb 26 – Mar 1, 2013. Academic Discussions

Visited IIT Kanpur during Mar 2 – Mar 8, 2013. Seminar Talk

**Vemparala, Satyavani**

Participated in *European Materials Research Society Meeting* held at Strasbourg, France during May 13 – May 18, 2012. Invited Talk: Force Fluctuations in unfolding forces of macromolecules

Participated in *INDO-US Symopsium on structure dynamics and mechanics of biological membranes* held at Bangalore, India during Dec 29 – Dec 31, 2012. Invited Talk: Interactions of biomimetic antimicrobial polymers with cell membranes

## 5.3 Visitors from Other Institutions

| | | |
|---|---|---|
| **Sebastian Horrath** | 6.5.12 - 13.5.12 | University of carter-bery,Chirst Church, Newzealand |
| **Senti Imsong** | 20.5.12 - 23.5.12 | IISC, Bangalore |
| **Jaban Mehar** | 29.4.12 - 30.5.12 | HRF, Allahabad |
| **Bastien Maubert** | 16.6.12 - 28.7.12 | IRISA, RENNES, France |
| **Medha Sharma** | 18.6.12 - 12.7.12 | Research Scholar Jamia Millia Islamia, New Delhi |
| **Kallol Sen** | 7.7.12 - 20.7.12 | IISC Bangalore |
| **Partha Bagchi** | 1.8.12 - 31.8.12 | I.O.B, Bhubaneswar |
| **Mayurakshinag** | 22.9.12 - 13.10.12 | University of calcutta |
| **M.Vanitha** | 15.10.12 - 25.10.12 | Bharathida Sch University, Tirichy |
| **SafdarQuddas** | 31.10.12 - 2.11.12 | Washington University, U.S.A |
| **Mohad Farouq Azam** | 12.11.12 - 16.11.12 | France |
| **Nisha Katyal** | 1.12.12 - 14.12.12 | JNU New Delhi |
| **Oliver Margetts** | 7.12.12 - 1.1.13 | Lancaster University |
| **Senthil Kumar. K** | 2.10.12 - 31.12.12 | HRI Allahabad |
| **Robert Crowston** | 10.12.12 - 22.12.12 | Royal Holloway University, University of London |
| **Sangale Usha** | 1.12.12 - 22.12.12 | Nandel, Maharashtra |
| **Januvarma** | 24.12.12 - 28.12.12 | U.S.A |

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|---|---|---|
| **Oliver Margetts** | 1.12.12 - 31.12.12 | University of Lancaster |
| **Gabriele Muciaccia** | 1.2.13 - 21.2.13 | Royal Halloway, University of London |
| **Manoj kumar Mandal** | 26.1.13 - 13.4.13 | Allahabad |
| **Maguni Mahakhud** | 1.3.13 - 31.7.13 | HRI Allahabad |
| **Taushif Ahmed** | 4.3.13 - 13.4.13 | HRI Allahabad |
| **Narayan Rana** | 4.3.13 - 13.4.13 | Allahabad |
| **M.Vanitha** | 25.2.13 - 25.3.13 | Centre for non liner Dynamic Bharathidasan Univer.Tirichy |
| **Abhiram Soori** | 20.3.13 - 21.3.13 | I.S.I Banglore |
| **Anirudh Pradhan** | 8.4.12 - 12.5.12 | Hindu P.G.College, Zamania,Ghagipus, U.P |
| **Dharmvir Ahluwag** | 6.5.12 - 13.5.12 | University of Canterburg,Christ Church, NewZealand |
| **K. Reji Kumar** | 9.5.12 - 15.5.12 | NSS College,Pandalam |
| **M. Lakshmanan** | 26.3.12 - 27.3.12 | Bharatidasan University, Tirichy |
| **Prabal Paul** | 12.5.12 - 13.5.12 | C.R.Rao AIMSCS, Hyderabad |
| **Ram Murthy** | 9.5.12 - 5.6.12 | Queens University |
| **T.R. Seshadri** | 16.5.12 - 19.5.12 | University of Delhi |
| **B.Anantha Narayan** | 20.5.12 - 23.5.12 | ISI,Banglore |
| **Naveen Garg** | 21.5.12 - 22.5.12 | IIT Delhi |
| **Ramamurthi Ravi** | 21.5.12 - 26.5.12 | Prof.Carnegre, Pittburgh |

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|---|---|---|
| **Roman Sverdcov** | 9.5.12 - 8.8.12 | Institute Visitor |
| **Mukul S.Laad** | 18.3.12 - 17.6.12 | Max - Planck Institute,Germany |
| **Philipklein** | 23.5.12 - 30.5.12 | Brown University, USA |
| **Anirban Roy** | 28.5.12 - 1.6.12 | Assam University, Assam |
| **Rajmohan Rajaraman** | 25.3.12 - 2.6.12 | North eastern University, Boston |
| **Subinay Das Gupta** | 27.5.12 - 7.6.12 | University of Calcutta |
| **Prahla Harsha** | 31.5.12 - 5.6.12 | TIFR, Mumbai |
| **K.Moorthy** | 30.5.12 - 8.6.12 | The American College, Madurai |
| **G.V. Ravindra** | 2.6.12 - 12.6.12 | University of Missouri |
| **S.S.R.Inbanathan** | 6.6.12 - 8.6.12 | The American College, Madurai |
| **Bireswar das** | 20.5.12 - 20.6.12 | IIT Gandhinagar |
| **Samir Kun Kri** | 9.6.12 - 29.6.12 | Asst.Prof. Barrakpore, West Bengal |
| **Shyama Shree Upadhyay** | 31.5.12 - 16.6.12 | IIT Guwahat |
| **Jitendriya Swain** | 20.6.12 - 29.6.12 | IIT Guwahat |
| **Mukul S.Laad** | 14.3.12 - 14.6.12 | Max Planck Inst. Dresden, Germany |
| **Ganesh Sundaram** | 3.6.12 - 8.7.12 | Amirta Vishna Kollam |
| **Swarnendu Sarkar** | 12.6.12 - 1.7.12 | University of Delhi |
| **K.U.S.Shivachaitanya** | 20.6.12 - 1.7.12 | BITS Pilani. Hyd. Campus |
| **Jayadev Athreya** | 21.7.12 - 5.7.12 | USA |

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|---|---|---|
| **M.Sanjay Kumar** | 18.6.12 - 15.7.12 | S.N. Bose National Centre for Science, Kolkatta |
| **Hilda Cerdeira** | 4.7.12 - 7.7.12 | University of Sao Pano |
| **Michael Lan** | 5.7.12 - 17.7.12 | University lard Quebac,Canada |
| **R.Thanadurai** | 24.6.12 - 16.7.12 | Allahabad |
| **Somshubhro Bandyopadhyay** | 2.7.12 - 15.7.12 | Kolkatta |
| **Sudesana sinha** | 8.7.12 - 11.7.12 | IISER Mohali |
| **Aninda Sinha** | 10.7.12 - 11.7.12 | Institute of C.V.Raman |
| **Dibyendudas** | 11.7.12 - 13.7.12 | IIT Bombay, Mumbai |
| **T.R. Govindarajan** | 1.6.12 - 31.7.12 | CMI Chennai |
| **Vinod Chandran Variyam** | 9.7.12 - 13.7.12 | University of Nebraska |
| **Shakir Aci** | 13.7.12 - 22.7.12 | A.M.U., Aligarh |
| **Rajdeep Niyogi** | 15.7.12 - 21.7.12 | Asst. Professor |
| **Supratik Chakraborty** | 21.7.12 - 22.7.12 | I.I.T. Bombay |
| **Gagan Mohanty** | 19.7.12 - 20.7.12 | TIFR Mumbai |
| **R. Parthasarathy** | 17.7.12 - 26.7.12 | Bharathiyar University, Coimbatore |
| **Anish Ghosh** | 23.7.12 - 28.7.12 | University of East Anglia |
| **M. Manickam** | 1.8.12 - 19.8.12 | KSOM, Calicut |
| **Ajit M. Srivasthava** | 1.8.12 - 30.9.12 | I.O.P Bhubaneswar |

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|---|---|---|
| **Indrajitmitra** | 5.8.12 - 31.8.12 | University of Calcutta |
| **B. Ramakrishnan** | 5.8.12 - 15.8.12 | HRI, Allahabad |
| **J. Pasupathy** | 5.8.12 - 10.8.12 | I.I.S.S. Banglore |
| **Ajitiqbac Singh** | 11.8.12 - 18.8.12 | INSA Senior scientists, New Delhi |
| **Vijaykumkar Murthy** | 26.7.12 - 10.8.12 | |
| **Girish Setlur** | 17.8.12 - 17.8.12 | IIT Guwahat |
| **Krishnaswami** | 10.8.12 - 20.8.12 | University of Florida |
| **Indubalasatija** | 19.8.12 - 23.8.12 | George Mason University, Fairfax |
| **Andreas krebs** | 19.8.12 - 28.8.12 | Germany |
| **Markusblaeser** | 20.8.12 - 25.8.12 | Germany |
| **Kapilhparanjape** | 19.8.12 - 21.8.12 | NISER, Mohali |
| **Debargha Banerjee** | 1.9.12 - 31.12.12 | Australian National University, CMA |
| **R. Parthasarathy** | 1.9.12 - 5.9.12 | Bharathiar University, Coimbatore |
| **Arvind Kumar** | 13.9.12 - 15.9.12 | Bhagalpur |
| **Braj Bhushan Tiwari** | 13.9.12 - 16.9.12 | Bhagalpur, Bihar |
| **Vibha Rani** | 19.9.12 | |
| **Yogesh Chandra Pandey** | 14.9.12 | |
| **I. Arnold Emerson** | 2.10.12 - 6.10.12 | Vellore |
| **A. Raghuram** | 4.10.12 - 12.10.12 | IISER, Pune |

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|---|---|---|
| **Anupam Kumar Singh** | 2.10.12 - 7.10.12 | IISER, Pune |
| **Chandan Singh Dalawat** | 1.10.12 - 15.10.12 | HRI, Allahabad |
| **Oesterle Joseph** | 1.10.12 - 31.12.12 | University of Paris |
| **S.D.Adhikarl** | 7.10.12 - 13.10.12 | HRI, Allahabad |
| **Gyan Prakash** | 7.10.12 - 16.10.12 | |
| **Debraj Chakrabarti** | 8.10.12 - 11.10.12 | TIFE, Banglore |
| **V.Kumar Murthy** | 30.9.12 - 12.10.12 | University of Toronto, Canada |
| **H.C.Nainwal** | 11.10.12 -17.10.12 | Garhwal University, Srinagar |
| **Olugbenbusola** | 17.9.12 - 4.2.12 | University of Lagos, Nigeria |
| **Samir Kunkri** | 25.10.12 - 14.11.12 | Mahadevandlanda, Kolkatta |
| **Guruprasadi Kar** | 30.10.12 - 10.11.12 | ISI Kolkatta |
| **Swarup Poria** | 25.10.12 - 12.11.12 | University of Calcutta |
| **S.Ramakrishna** | 6.11.12 - 23.11.12 | North Western University, USA |
| **Mrinalkanti** | 4.11.12 - 10.11.12 | Kolkatta |
| **I. Arnold Emerson** | 14.11.12 - 17.11.12 | VIT, Vellore |
| **Sumedha** | 18.11.12 - 24.11.12 | NISER, Bhubaneswar |
| **Prahladh Harsha** | 25.11.12 - 4.12.12 | TIFR Mumbai |
| **Anil Kumar Karan** | 2.12.12 - 15.12.12 | NISER, Bhubaneswar |

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|---|---|---|
| **M.Manickam** | 8.12.12 - 15.8.12 | Calicut |
| **Michael R** | 5.12.12 - 12.12.12 | Australia |
| **Frances Rusamund** | 5.12.12 - 12.12.12 | Australia |
| **R. Parthasarathy** | 9.12.12 - 30.12.12 | IISER, Pune |
| **V.Sunitha** | 6.12.12 - 31.12.12 | Gujarat |
| **Hai-yang Cheng** | 14.12.12 - 15.12.12 | Taiwan |
| **H. Fritzsch** | 8.12.12 - 18.12.12 | LMU Munich |
| **Andrelurgde Gourea** | 9.12.12 - 18.12.12 | U.S.A |
| **S.D.Aduikari** | 16.12.12 - 19.12.12 | HRI Allahabad |
| **Sheldonstone** | 8.12.12 - 18.12.12 | Syracuse University |
| **Marina Artuso** | 8.12.12 - 18.12.12 | Syracuse University |
| **Nutanlimaye** | 17.12.12 - 29.12.12 | IIT Bombay |
| **Andreaskrebs** | 17.12.12 - 28.12.12 | Germany |
| **Steve olsen** | 15.12.12 - 21.12.12 | Seoul National University, Seoul |
| **OesterleJoseph** | 28.9.12 - 5.1.13 | University of Paris |
| **V.Kumar Murty** | 23.12.12 - 3.1.13 | Canada |
| **Ram Murthy** | 5.12.12 - 3.1.12 | Canada |
| **A.M.Srivastava** | 2.1.13 - 7.1.13 | Bhubaneswar |
| **Sandip Pakvasa** | 2.1.13 - 6.1.13 | University of Hawai |

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|---|---|---|
| **Amihay Hanany** | 15.12.13 - 16.12.13, 22.12.13 - 7 .1.13 | Imprial College |
| **Nilendra Ganesh Deshpande** | 2.1.13 - 9.1.13 | |
| **V.Parameswaran Nair** | 2.1.13 - 7.1.13 | City College of City University of New York |
| **Prahladh Harsha** | 4.1.13 - 12.1.13 | TIFR, Mumbai |
| **Prashanth Jaikumar** | 8.1.13 - 11.1.13 | USA |
| **Sridharadasu** | 9.1.13 - 11.1.13 | University of Wisconsin |
| **P.K. Sahoo** | 11.1.13 - 15.1.13 | Bits Palani, Hyderabad |
| **Paritoshpandya** | 9.1.13 - 17.1.13 | TIFR, Mumbai |
| **Hanj Van Ditmarsl** | 13.1.13 - 19.1.13 | University of Sevilla |
| **C.S.Narayana Murthy** | 25.1.13 - 27.1.13 | IIST, Tirichy |
| **Subinay Das Gupta** | 20.1.13 - 2.2.13 | University of Calcutta |
| **Pietro Corvaja** | 25.1.13 - 3.2.13 | University of Udine |
| **Kashyar Rajeevsarathy** | 29.1.13 - 1.2.13 | IISER Bhopal |
| **Pushan Majumdar** | 30.1.13 - 1.2.13 | Indian Association for the cultivation of Science |
| **Naresh Dadhich** | 30.1.13 - 1.2.13 | IUCAA, Pune |
| **Rekha S‘:w anthanam** | 3.2.13 - 5.2.13 | IIT Bombay |
| **Matthias Brack** | 5.2.13 - 28.2.13 | University of Regenburg, German |
| **Arnold emerson** | 17.2.13 - 12.2.13 | VIT University, Vellore |
| **R.Thangadurai** | 9.2.13 - 13.2.13 | HRI,Allahabad |

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|---|---|---|
| **Navinder Singh** | 12.2.13 - 16.2.13 | PRL Ahmedabad |
| **Som Shubhro Bandyopadhyay** | 11.2.13 - 16.2.13 | Bose Institute, Kolkatta |
| **Winfried kuhnen** | 12.2.13 - 18.2.13 | University of Heidelberg |
| **Rajat Bhaduri** | 5.2.13 - 28.2.13 | MC Master University, Canada |
| **Manjunath Krishnapur** | 13.2.13 - 15.2.13 | ISI Banglore |
| **Alakadas** | 17.2.13 - 25.2.13 | Jadavpur University |
| **Ram Kishore** | 24.2.13 - 28.3.13 | Research Scientist |
| **K.Natarajan** | 25.2.13 - 25.2.13 | JNV, Delhi |
| **Ajitiqbali Singh** | 16.2.13 - 27.2.13 | ISI, New Delhi |
| **Deshouillers Jean-Marc** | 19.2.13 - 2.3.13 | University de bordeaux, France |
| **Tzuchiang Yuan** | 20.2.13 - 7.3.13 | |
| **Arnab Rai Choudhuri** | 26.2.13 - 28.2.13 | |
| **P.K.Mohanty** | 27.2.13 - 28.2.13 | SINP |
| **Maury goodman** | 28.2.13 - 1.3.13 | ANL |
| **Aarthi Ajit** | 28.2.13 - 4.3.13 | Centre for public History |
| **R.Thangadurai** | 18.2.13 - 28.2.13 | HRI, Allahabad |
| **Jyotipratim Raychaudhuri** | 4.3.13 - 6.3.13 | Katwa College |
| **Biswambharpahi** | 4.3.13 - 6.3.13 | University of Rajasthan |

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|---|---|---|
| **Samirnath Mallik** | 5.3.13 - 14.3.13 | ISI, Kolkatta |
| **P.K.Manoharan** | 5.2.13 - 6.2.13 | RAC-NCRA-TIFR |
| **M.Manickam** | 6.3.13 - 13.3.13 | Kerala School of Maths Kozhikode |
| **Prahladh Harsha** | 3.3.13 - 11.3.13 | TIFR, Mumbai |
| **Gautam Vishwanath** | 10.3.13 - 12.3.13 | Film-Maker, Center for Public History |
| **Jacobotoran** | 6.3.13 - 16.3.13 | University of Ulm,Germany |
| **RamKishore** | 25.3.13 - 30.4.13 | INPE, Brazil |

# Chapter 6

# Infrastructure

## 6.1 Computer Facilities

### Enhancement of Computer Facility during 2012-2013

**Hardware facility:**

- The IMSc network was upgraded to 24 Mbps(1:1) Internet Bandwidth through leased line(fiber loop).
- Additional LAN switches, LAN sockets and rack upgradation were made in the Library building(L1) and in the new office spaces for Technical Assistants.
- Broadband solutions with WiFi access facility were enabled in the off-campus accommodations provided for students.
- A Dell Power Edge R715 rack server with AMD Opteron 6344 processor was installed for enabling JEST related operations. The server was maintained at IMSc for JEST with the funds from JEST-2013, Saha Institute of Nuclear Physics, Kolkata.
- A flatbed scanner HP Scanjet 8270 with ABBYY Fine Reader 11 professional & ABBYY PDF Transformer was installed in the Library.
- A new ATEN KVM Extender was installed in the Ramanujam Auditorium for connecting Laptop and Projector.
- **Hardwares for Media Center purchased under NMIECT project:** The following hardwares were purchased and installed in the Media Center Facility for making remote conferencing, remote meetings, to conduct Viva voces and remote classes with other institutions.
  - A portable streaming server N-Cast PR-720M(capture, recorer and stream) compatible with WXGA/HD 720p, H.264 having 64 GB SSD storage was made available for media center activity.
  - Professional video camera Panasonic AG-AC90 with 2x32 GB SD memory cards, Libec 650 tripod, HDMI cables and high quality microphone were added in the media center.

  - A Media Server "Supermicro Super Storage 6027 R-E1R12N" was configured for archiving media files with enabling access through portal page.
  - LifeSize SoftPhone licenses were installed in Laptops for making point-to-point Video Conferencing session.
  - An NEC NP M260 XGS 2600 lumens projector was included in the media center.

    By utilising the Media Center Facility we could successfully make the **remote-classes for the IISER-Mohali students from IMSc**.

**Software facility:**

- The Mathematica version 9 Software with 25 users license was upgraded in the network.
- SuSE Linux OS & S/W of ICE (Annapoorna) HPC Cluster upgraded with new versions SLES-II and SGISMC.
- Matlab 2012b with 20 user licenses and its toolboxes were also upgraded

## 6.2 The Library

The Institute Library holds a total collection of 67799 books and bound periodicals as on March 31, 2013. This includes an addition of 565 volumes during the current year April 2012 - March 2013. The NBHM has recognized this Institute library as the Regional Library for Mathematics. An average of about 6000 outside users in a year from colleges, universities and research institutions from different parts of the country make use of the library facilities for their academic and research information needs.

The library has a well balanced collection both print and online on the major subject areas of research such as Theoretical Physics, Mathematics and Theoretical Computer Science. The library subscribes to over 350 national and international journals.

The library has access to over 3500+ online journals from major publishers such as Elsevier, American Mathematical Society, American Physical Society, Springer Verlag, World Scientific, Institute of Physics, Wiley, etc.

Library has also access to Nature online, Science Online, ACM Digital Library, SIAM Journals Archive, Duke Mathematical Journal, and JSTOR Full digital archive. It has also perpetual online access to backfile collection of journals contents from Volume 1 from some of the major publishers like Elesevier under DAE consortium, Springer, World Scientific, Wiley, deGruyter, Cambridge University Press, Turpion, IOP Publishing and Annual Reviews Electronic Backvolume collection.

Access to online journals is restricted to members of the Institute.

### Services

Apart from developing the collection, the library offers reprographic and inter library loan services. Using Libsys software on a linux platform, the library catalogue has been computerized and made available online to the readers both within and outside the Institute Campus. Online request for acquisition of books and status of borrowings have also been enabled using Libsys. Library has implemented RFID based system for self check-in and checkout of library materials. The library also provides effective 24x7 access to its resources with the help of RFID enabled access control system, perhaps the only library of this kind in the country.

Library has a website dedicated to host all the electronic information resources and to provide information about the library and its services.

Library is a member of DAE Libraries Consortium that subscribes to SCIENCE DIRECT SERVICE of Elsevier.

Library is also coordinating the MathSciNet consortium which provides online access to MathSciNet for 8 participating institutions at a deeply discounted rate in the southern region.

Library is an institutional member of AMS, MALIBNET, CURRENT SCIENCE Association, and IAPT.

### Acknowledgment

The Library gratefully acknowledges the donation of valuable books, journals and other reading materials received during the current year from the persons and organizations mentioned below:

Arvind, V., IMSc
Baskaran, G., IMSc
Kamal Lodaya, IMSc,
Ritwik Mukherjee, IMSc,

Balasubramanian, R., IMSc
Jeanne Scott, IMSc,
Ronojoy Adhikari, IMSc

Prema, IMSc

Victor Anandam, IMSc

Korb, Kein B.

Si Si, Aichi Perfectural University

ACM

DAE

NBHM
Mathematical Society of Japan

NPCL